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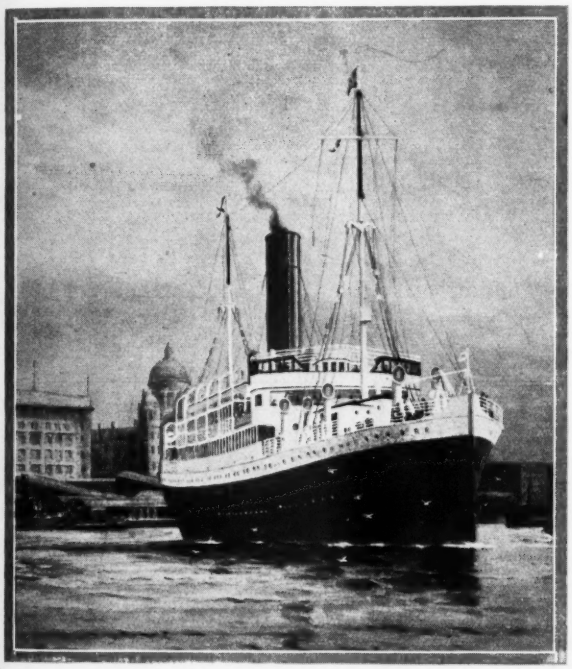

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CONTENTS.

	Pages
Editorial Notes	139
Catalysis and Cancer: A Hint to Pathologists	141
Saving the Indian Totem Poles	144
Correspondence	148
Russian Expeditions to the Black Desert	149
Books Received	152
How and Where to Observe the Total Eclipse	153
Biological Control of Pest Plants	157
Bird-Marking: Its Prospects and Results	159
Civil Aviation Spreads its Wings	164
Broadcasting: A New Social Force	168
Book Reviews	170

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DISCOVERY

A Monthly Popular Journal of Knowledge

Vol. VIII, No. 89. MAY, 1927. PRICE 1s. NET

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Editorial Notes.

IN issuing this month a special Travel Number, we have in view that interest in exploring new fields which most of us experience as summer and its prospects of holidays approach. This year an added attraction awaits us in the total eclipse of the sun that will take place on 29th June. As this phenomenon has not been visible in England for more than two hundred years, everyone who can possibly do so should arrange to travel north to see it next month, or to Norway or Sweden, an article on another page giving full particulars of how to make the most of this unique occasion. In this connexion our contributor, Dr. Carroll, has prepared a detailed map of the path of totality through Scandinavia, maps of the English area being readily available; and as the eclipse is of only a few seconds duration, it must be studied in advance to be fully appreciated. Besides this article of travel interest, we publish an account that will provide a new attraction for visitors to Canada, of the Government's work in preserving the Indian totem poles there, while another contribution describes recent Russian expeditions into unexplored parts of the Black Desert in Turkmenistan. In an article entitled "Civil Aviation Spreads its Wings," the European and other air services are described, with maps of new routes, and in our advertisement pages details will be found of several attractive cruises, including a forthcoming world tour by "The Empress of France."

New excavations at Corinth, under the auspices of the American School of Classical Studies in Athens, have yielded results "surprising and gratifying beyond all expectations." In a lecture delivered at Princeton some weeks ago, and reported in the university journal, Dr. Theodore Shear stated that the principal achievement last season, in continuance of work he had begun in 1925, was the discovery and exposure of the famous sanctuary of the goddess Athena, which had remained buried since the Romans sacked Corinth in 146 B.C. This sanctuary was the most sacred in the city, for according to Greek legend it was while sleeping there that the hero Bellerophon saw Athena place on the altar the golden bridle, with which he caught the winged steed Pegasus. Mounted on this horse Bellerophon killed the Chimaera, and then tried to fly to heaven, only to fall to earth, while Pegasus continued his ascent and was placed among the stars. Excavation of the sanctuary yielded a remarkable quantity of statuary and other objects ranging in date from the Byzantine era to the seventh century B.C., while in the great theatre of Corinth, which was also cleared by Dr. Shear, hitherto unknown structural elements were revealed. Thus brilliantly coloured paintings appear on the circumference wall and curiously cut bridge blocks were discovered over the water-channel in the orchestra. The painted scenes of gladiators and acrobats are stated to be unique for their period.

* * * * *

The sum of one hundred thousand pounds which has just been put at the disposal of this same American School in Athens, for starting excavations at Agora, is probably unsurpassed in the history of archaeology. But it is typical of a generosity lavished on educational endeavour and research in the States, with which British standards do not compare favourably. Thus the further excavations undertaken during the winter at Ur by Mr. Wooley have had to be abandoned before the end of the season for want of funds, while the full sum appealed for by Sir Frederick Kenyon on behalf of the British Museum expeditions to

Honduras has not yet been forthcoming. Undoubtedly the present condition of trade goes far to explain this lack of support, but those who not infrequently boast of the older cultural traditions of this country would do well to emulate America in ensuring that any stone which may add to our knowledge of the past shall not remain unturned.

* * * * *

According to an announcement by Signor Mussolini on the occasion of his admittance last month to the Royal Society of Italian History, excavations are shortly to be recommenced at Herculaneum, the buried city near Naples. We publish on another page a photograph giving a typical view of the small part already exposed, from which the character of the site can be clearly seen. The modern houses at the top of the picture show the present level of the town of Resina, which has grown up over the site of the lost city. In the open space a number of houses have been carefully excavated and restored, but the theatre and some of the public buildings are far below this level, and are at present only to be reached by tunnels made through the lava bed in which Herculaneum is buried. To facilitate restoration, the Italian Government intend to photograph immediately every discovery made in the course of the new excavations, a practice that is now becoming usual in such work and was recently carried out in detail by Dr. George Reisner when he unearthed the pyramid tombs near Giza.

* * * * *

In reviewing "The Great Delusion," from which extracts were reproduced in *Discovery* last month, a leading newspaper remarked that no book of recent times had provoked such instantaneous controversy. It was therefore to be expected that the enterprising publishers of the "To-day and To-morrow" series should take advantage of this interest to attach a special note to a volume they happened to be issuing expressing a contrary view, which on the cover states: "The doubts raised by 'Neon' in 'The Great Delusion' about the possibilities of aircraft developments in the future, and the wisdom of spending money on this branch of science, can be stilled only by adequate knowledge of the true potentialities of aviation. Oliver Stewart in 'Aeolus' provides strong reasons for believing that 'Neon' is mistaken and his policy disastrous." In consequence we took up this new volume with great interest, only to discover with greater regret that its arguments cannot be compared with those of the author it purports to answer, or with the high standard of a series which has contained so many distinguished contributions. It should here be remarked that in view of the seriousness of the challenge to accepted views on the science of flight we should welcome an authoritative answer to Neon's statements which concern accepted laws rather than matters of controversial opinion. The most casual glance at "Aeolus, or the Future of the Flying Machine" (Kegan Paul, *2s. 6d.*), will, however, suffice to show that it contains assertions unsupported by fact. After prejudicing his case on an early page by belittling the fact that "scientists have demonstrated" that some of the things he suggests are "impossible," the author's opinion that the future of flying will be affected "more by the attitude which the world adopts towards it than by technical achievement," is a logical one. But is is hardly in keeping with his later conclusion that "scientific research" can be "relied upon" to construct flying ships capable of carrying 2,000 passengers, especially when he describes the modern British motor-car as "a dismal, abysmal mass not containing a single original idea."

* * * * *

A new process for recovering cellulose from cornstalks is reported from New York. It is the invention of a Hungarian chemist named Dorner, from whom the American rights have been purchased by a group of industrialists including a prominent figure in the Shell oil corporation, and its value lies in the conversion of what was formerly waste material into a marketable product. Not only are there enormous possibilities in the conversion of cellulose into alcohol for motor fuels—as was described in Professor Kipping's lecture reported in our columns last month—but being the chief component of all vegetable tissues, cellulose is employed in immense quantities in the manufacture of textiles and paper. In other forms it is used for making artificial silk, cinema films, explosives and many such products, and as cornstalk cellulose is said to produce artificial silk superior to that made from wood pulp, a large demand for it should be ensured. The Dorner process will also provide a valuable means for disposing of cornstalk infested with the cornborer pest.

* * * * *

At the moment of going to press we learn with the deepest regret of the serious illness of Sir Arthur Shipley, Master of Christ's College, Cambridge. A valued friend to *Discovery*, Sir Arthur has written on many subjects, chiefly of biological interest, and is one of those distinguished scholars who spare no efforts to bring science within the ken of the ordinary man. We are sure we are voicing the sincere feeling of all readers in wishing him an early recovery to complete health.

Catalysis and Cancer: A Hint to Pathologists.

By Sir Oliver Lodge.

Recent investigations into the abnormal behaviour of gas-filled lamps when these contain impurities —which set up "catalytic" reaction in the filament, the impurities promoting reaction without themselves being changed by it—have suggested to Sir Oliver Lodge a parallel explanation for the cause of cancer. We venture to describe his article as a "hint" to pathologists, as interesting possibilities are naturally indicated by Sir Oliver's new thesis.

A SUGGESTION has lately been made that I think might be repeated in these columns, inasmuch as it refers to a peculiar trouble noticed in connexion with the manufacture of lamps and valves, which seems to indicate a possible explanation for the cause of cancer. It seems specially to apply to gas-filled lamps, where the gas introduced ought to be quite inert, like argon, so as to have no chemical action whatever on the filament. But although pure argon is introduced, it is very difficult to exclude traces of moisture; for glass is well known to occlude it as a surface layer. It is this surface layer of moisture that makes ordinary glass a bad insulator. Nearly all glass used in frictional electricity has to be dried before it is efficient, though it is true that some kinds of glass condense moisture more easily than others.

Influence of Moisture.

Any moisture condensed on the glass gradually evaporates into the vacuum or gas inside the bulb, and there proceeds to attack the tungsten filament in a curious way known to chemists as "catalysis." Perhaps it is as well to explain to some of my readers that catalysis means the action of some element or compound in promoting chemical reaction without actually taking part in it. A very minute trace of a suitable substance may serve gradually to bring about a great deal of chemical action, since the catalytic substance is not consumed or diminished by the action that it promotes. Sometimes it serves as a stimulus, promoting an action that, once started, continues rapidly of itself, but that would not be able to begin without its outside assistance.

For instance, a bulb full of equal parts of hydrogen and chlorine is known to be able to explode in the presence of ultra-violet light from, say, a magnesium wire, with the instantaneous production of hydrochloric acid, and the shattering of the bulb with a loud noise. It is remarkable how quickly such a bulb responds to ultra-violet light, either from ignited magnesium or from an arc. But it has been found by chemists that if the hydrogen and chlorine gases are perfectly pure and dry, the action will not occur. To enable the bulb to act efficiently it must contain a trace of moisture. In practice it always does, unless special precautions are taken. I have been told by chemists that even hydrogen and oxygen will not combine if they are absolutely dry. How the molecules of water act in such cases is not very easy to say. They do not take part in the action, but they promote it, and without them it does not occur.

I don't know that it is a good analogy, but it might be said that a navvy making an embankment, or a canal, or both—that is, removing soil from one place and piling it up in another—would require the aid of a wheelbarrow, which remains just as good at the end of the operation as at the beginning, and so might be called a catalytic agent. Mr. Paterson and his co-workers in the laboratories of the General Electric Company have shown that water vapour acts like a wheelbarrow, or, as he says, like ants. It tends to remove the tungsten from the hotter part of the filament and pile it up in another; an action that, once begun, will go on rapidly, because the weakened portion of the filament will be extra-heated by the current, while the thickened portion will be cooler than the rest; so that in a short time, by the growth in one place, and the wastage in another, the filament is destroyed.

A Kind of Disease.

Hence it might be picturesquely said that lamps are subject to a kind of disease, or that a trace of water vapour acts as a kind of poison, for in its presence the tungsten filament is unhealthy, subject to alternate wastage and growth which, perhaps fancifully, perhaps even seriously, might be likened to cancer in the human body. Whether the analogy is real, or only fanciful, must remain for pathologists to decide. Some of them already think that cancer is not due to a microbe, as so many other diseases are. It is at least conceivable that foreign substances in the blood, for instance, ionized salts, might attack the tissues in one place and build them up in another, and that such an action, once started, might go on at an increasing rate.

One must be very careful in making suggestions of a medical character, for to most of us the human body is an unknown quantity. All manner of unknown processes are going on in it, and pathologists are the only people competent to have an opinion as to what is occurring or what is likely to occur. But sometimes a hint from another branch of science may be serviceable, and therefore I risked to *Nature* the letter that here follows reprinted from its issue of March 12th :—

" At a recent meeting of the Royal Society of Arts on 16th February, an interesting paper, accompanied by experimental demonstrations, was read by Mr. C. C. Paterson, director of the research laboratories of the General Electric Company at Wembley ; and from this paper I want to make a few extracts in order to attract wider attention to some of the results obtained by the brilliant staff at work there under exceptionally favourable conditions. The thorough knowledge necessary before trustworthy pieces of apparatus can be manufactured and turned out by the million is obvious, and the experience gained in the organization of such mass-production is often of scientific importance. Here, then, is one of the side-issues of lamp and valve manufacture.

" It is found that in gas filled lamps, the filaments of which are made of tungsten, it is essential to reduce the residue of water vapour down to the lowest minimum possible ; for water vapour has, on the coiled filaments of such lamps, a specific and recognized action that gradually and sometimes rapidly weakens and destroys the ignited filament, by thinning it down at one place and thickening it in another ; the action, once begun, tending to go on more and more rapidly, since the thinner part gets automatically more heated and the thicker part more cooled. The action is described by Mr. Paterson as follows :—

Molecules of water vapour left in the bulb are decomposed into hydrogen and oxygen in contact with the hot parts of the filament. The oxygen immediately combines with some of the tungsten atoms at the hottest spots with the formation of tungsten oxide. This tungsten oxide is deposited on to a neighbouring cooler part of the filament where reduction of oxide can take place, since the cast-off hydrogen atoms can again claim their oxygen from the tungsten oxide. The tungsten atoms thus left coalesce with the filament at its cool point, with consequent thickening of the filament. Meanwhile the molecule of water vapour, now re-formed, is free to attack again the hotter part of the filament. This point becomes continuously hotter by virtue of its diminishing diameter. Thus the molecules of water vapour act much as ants, carrying particles of tungsten from one place and building them up in another, and become available over and over again as the carriers of tungsten atoms. Hence the potency of water vapour as a destructive agent. The quantity must be reduced to vanishing proportions if it is not to cause wastage and growth in this way during the long high-temperature life of a gas filled lamp.

" That water should act as a catalytic poison, in this way, is rather in accordance with the pronouncements of Prof. H. E. Armstrong about the influence of water and of traces of impurity in chemical reactions generally ; for under other conditions traces of other substances may be acting in a similarly unstable or top-heavy way. In fact, Mr. Paterson elsewhere says that ' in gas filled lamps, and before gas filling takes place, every possible trace must be removed of water vapour, because this acts in relation to the gas filled lamp filament as cancer does in the animal body, and causes alternate local growths and wastage.' He further points out that at the high temperature of a lamp ' chemical reactions are extraordinarily vigorous, and many of them unexpected—water vapour is not the only vapour or gas which must be guarded against.'

" Whether there is likely to be any impurity in the blood or tissues that under vital conditions might act in a catalytic manner and build up local growths at the expense of tissue elsewhere, even in the absence of any microbe or customary disease agent, it is for biologists to decide. The idea may have occurred to them, but an actual instance occurring in the physical laboratory may cause them to pursue the idea further. I will only say this : The activity of an electrolyte capable of dissociation in a liquid—as in many saline solutions—is known not to be so very different from the activity of the free molecules of a gas."

Dissociation in Liquids.

Perhaps I had better expand the concluding sentence of this letter in case it is not clear to non-chemical readers of *Discovery*. When a salt of any kind (I do not mean only common salt, but any kind, such as sulphate of soda, potassium iodide, ammonium chloride, etc.) is dissolved in water, especially in very dilute solutions, the modern view is that the massive molecules of water somehow decompose or dissociate the salt into its two constituent elements, the atoms of which are charged with electricity of opposite sign.

Take potassium iodide as an example. It is broken up or dissociated by the water, in which the potassium atoms each have a positive charge, and the iodine atoms each have a negative charge. Whether this splitting up is really complete or not—and, if it is, whether the atoms wander about free or associated each with some molecules of water, or even whether the idea of dissociation is only a pictorial representation of something not quite so simple—on all those points chemists take different views. But the simplest plan is to assume complete dissociation ; the evidence for it being the way the solution behaves when

electrodes are immersed in the liquid, and a current passed between them. One of the plates, being positive, attracts the negatively charged ions; while the other plate, being negative, attracts the positive ions. Hence the potassium atoms travel downstream, with the current, towards the negative terminal, which is therefore called a "cathode" or downward path; while the negative ions travel against the current, or upstream, towards the "anode" or upward or high-level terminal; the "up" and "down" referring not to gravitational level but to electrical potential, which has a close analogy with level, so that similar terms are used.

Carriers of Current.

The evidence for the freedom of the travellers or ions is that the smallest E.M.F. is able to produce a proportional current, which in a liquid is necessarily a convection current, no current passing except what is carried by the charged travellers. The rate at which they go in a liquid is known, and as the charge is also known, so the number of travellers can be calculated in any given solution from its electric conducting power. If the ions at all clung together then it would seem that there ought to be some finite E.M.F. applied before they could be separated; but when tested very carefully no such finite E.M.F. is required to begin the current. The current is accurately proportional to the E.M.F. In other words, the liquid obeys Ohm's law just as accurately as does a metallic conductor, wherein the electrons are certainly free; though in a metallic conductor, strangely enough, we cannot count the electrons, for we do not know at what rate they travel. Conduction in gases and liquids is more open to observation, and therefore more is known about it than can be said of the much better-conducting metals.

If the solution is very dilute, the carriers are few, and the conductivity small. In other words, the resistance of slightly impure water is high. If we could get absolutely pure water (which seems almost impossible) it is doubtful if it would conduct at all. As the strength of the solution is increased by adding more salt, we reach at some stage a maximum conductivity, after which it is to be presumed the molecules of salt added are not dissociated, and therefore take no part in the conduction. Best conductivity means that there is a maximum number of travellers available for carrying the current. A number of complete molecules will only act as an obstructing crowd.

These being in a general way the facts about conducting liquids, or what are called electrolytes, it has been found that the free or practically free particles obey to a surprising extent the laws of gases. In a gas the molecules are not dissociated, unless the gas is ionized, but they are isolated and free from each other. They move about with great velocity at random, in a state of continual collision and rebound. It is owing to these collisions that a gas exerts pressure, and the rapidity of the molecular motion is determined by the temperature; in fact, physically speaking, it *is* the temperature or, more precisely, the square root of the absolute temperature.

The point of the remark, therefore, which forms the concluding sentence of the foregoing letter, is that whatever happens in a gas may be expected, with some differences, to occur in an electrolyte also. Now in a gas it was observed that a few molecules of water vapour had a catalytic and deleterious action on a tungsten filament, attacking it in the hottest parts, carrying the tungsten molecules away, and depositing them in the cooler parts, thus making a simultaneous wastage and growth on the filament, and this was likened to the activity of navvies building a mound. Or, indeed, we might liken it to the activity of builders in general, who hew stones from a quarry and erect a palace or a cathedral; the operators going about their business when finished, and being ready for another job, they are purely catalytic agents, entering or continuing in neither the excavation nor the erection; they are merely the means by which both excavation and erection are produced.

A Human Parallel Suggested.

The suggestion then is, for what it is worth, that this sort of process that goes on in a lamp, without any vital organisms or microbes but by the purely chemical activity of a catalytic agent, may conceivably under certain circumstances go on in the human body. For some foreign substance in the blood, which normally I should judge is not and ought not to be an electrolyte, may confer upon it these active chemical properties, so as to cause a wastage or excavation in some part of the tissues through which the blood circulates, and a piling up or a growth in other parts.

Electrolytes need not be salts, they might be acids. Indeed, acids are very efficient conductors, at any rate when dilute. And there may be a multitude of other substances that might be accused of the possibility of such an activity. It remains for experiment to decide whether there are any that really justify the accusation or the suspicion—for at present presumably it is nothing more than a suspicion.

In thinking over the kind of impurities likely to be introduced into the blood, which might have this

poisonous or deleterious effect of producing local growths, the first idea would be to think of active chemical agents, such as chlorine, iodine, and the like, as possibly the most efficient. But ordinary chemical activity is not necessary in a catalytic agent; such an agent need not be something conspicuously active in the chemical sense, it might be quite an innocuous and inactive substance. For instance, the disease of lamps is caused by the presence of water—than which it would be difficult to imagine a simpler and more harmless ingredient. It by no means follows that water is the only substance that can so act. The agent might be something of an apparently innocuous character, and yet it might be able to act catalytically. This enlarges the field of speculative choice, for the deleterious substance need not be a virulent poison; its evil effects might be only due to its having got out of place, that is, into surroundings where it is not wanted and where its influence is bad.

It would be rather groping in the dark for experimenters merely to try one substance after another by introducing it into the blood-vessels of, say, mice, and seeing what happens; but there may be some indication or guide or hint as to the kind of substances that might be introduced by different kinds of food, and these are the substances that it would be politic to try first. To proceed any further in this direction would need the experience of dietetic experts and medical men—an experience to which I myself can make no profession. But many qualified minds are directed to the subject, and sometimes a hint even from a branch of science outside medicine may be of possible use. It is nothing more than a hint, and continued experiment is necessary before it can be determined whether it is a useless or a helpful one. And those experiments must be conducted by trained pathologists, some of whom may also be wireless experimenters, and therefore might not disdain to take a hint from the great experience of manufacturers and investigators in the research laboratories of the General Electric Company, to whom the facts about tungsten filaments above utilized are due.

Saving the Indian Totem Poles.

By Harlan I. Smith.

Archaeological Department, Victoria Memorial Museum, Ottawa.

How these quaint symbols of Red Indian history and primitive art are being preserved and guarded by the Canadian Government is here described by one of the members of the official Commission appointed to carry out the work, from which much is being discovered about Indian tradition.

THE Indian totem poles of the Pacific coast of Canada have long been neglected. Many have fallen and decayed. Even less than twenty years ago the carved cedar memorial columns of at least two villages were burned by excited Indians in response to the urgings of the leading whites sent to work among them. But now a change has come. During the past two seasons of 1925 and 1926, the Canadian Government has been active in trying to save Indian totem poles in the villages where they were formerly erected. To this course it has been urged and assisted by the people of British Columbia, by artists, scientists, philanthropists, and leading business men. Though large and rough, totem poles are wonderfully artistic—an asset to the art of Canada and of great interest to the scientific student of totemism, anthropology and social organization. They are a comfort to many of the older Indians and objects of pride to some of the younger.

The work of preservation and re-erection of these symbols of Indian art was begun in 1925 at Kitwanga, an Indian village in British Columbia, where there are eighteen of these carved poles and two totem figures. One of the latter represents a mountain lion, the other a crab. This crab was formerly used in ceremonials. Two men would wear it and dance, working its mouth, eyes and legs by means of strings, so that in the dark, illuminated only by the fireplace, it appeared to the spectators as if the crab were dancing.

The totem poles are not gods or idols as some have thought, but are memorial columns carved from a red cedar tree which was carefully selected and brought to the village. They are made usually with figures arranged one above another and representing more or less ancient characters: men, eagles, ravens, wolves, bears, starfish, and even inanimate objects. These are the emblems of brotherhoods, clans and families, each illustrating the family history and stories connected with it.

Totem poles vary in size, a typical one being about forty feet high. A totem pole is erected as part of a funeral ceremony after the death of an important person, usually by one of the sister's children whom the

family considers of sufficient ability and wealth. This is the person who inherits the name of the deceased and the seat of honour connected with the name, and is not a son, as among ourselves, but someone from the mother's side of the family, usually a nephew. The pole is erected a year or two after the death, because it takes time for the family to make sure who is to inherit. It also requires time to gather the necessary property for distribution and the food for the accompanying feast, to say nothing of the time needed to secure an artist and have him carve and paint the pole. A carver on the father's side of the family is employed to make the pole. This person belongs always to a different brotherhood, and consequently has different emblems. Sometimes he gets someone else to do the actual carving, very much as we have honorary pall-bearers and actual pall-bearers. One of the emblems of the paternal relative employed to do the carving is sometimes carved upon the pole as a signature. In recent years some of the Indians have been using tombstones bought from white men in place of, or in addition to, totem poles. Many of these show some of the same emblems as those on the totem poles.

TOTEM POLES AT KITWANGA, BRITISH COLUMBIA.

The work of preserving these symbols of native art was begun by the Canadian Government at the Indian village of Kitwanga, where the poles are seen before reconstruction.

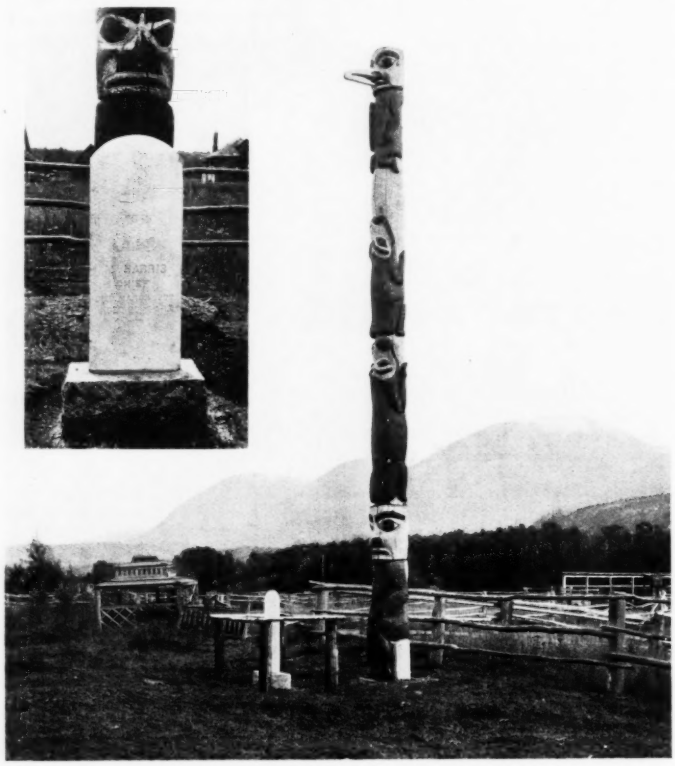
A description of one or two of the poles at Kitwanga will make their significance clearer. One, known as No. 6, is forty-one feet high, and named Oanom Keebu, "Pole of Wolf." It was erected in memory of a man having the title We Clots, "Large White Fish." He belonged to the Lakeebu, "Wolf Brotherhood." The present holder of the name We Clots is known to the white people as Jacob Morgan. It is carved from top to bottom with quaint figures and emblems representing bears, hunters, women and children, and the story it illustrates is as follows:—

A chief of the Lakeebu, "Wolf Brotherhood," had a beautiful daughter named Hpeesunt and two sons, one named Akteeih. Hpeesunt mocked at the bears. For her punishment the bears in human form pursued her; but one of their leaders, a grizzly bear, protected her and took her up to his den on the mountain side. She changed into a bear and bore him twin sons, half human and half bear. Meanwhile her brothers constantly searched for her. The bear prophesied that her people would come and kill him, and he taught her two songs, saying that the hunters ought always to be respectful to the bears they kill, and sing these songs. At last she saw Akteeih searching for her on the mountain far below. She made a snowball and threw it down. He picked it up and observed the impression of her fingers. He then looked for her, and found her in the bear's den. He killed the bear and took his sister and her bear children home. The children behaved like bears part of the time, and they helped their uncles in hunting by directing them to the bears. They frequently pointed to a column of smoke in the mountains and said: "That is grandfather's house." Akteeih would then go to the place, where he always found a bear's den. This help is what enabled the family of Akteeih to be prosperous in snaring bears.

Another pole, known as No. 11, is called Ganemtainhlik, meaning the totem pole of the Squirrel. It was carved, as was customary, by a paternal relative of the person in whose memory the pole was erected. This carver was Gwinhu, and he was a Kitwancool chief of the Laksal Brotherhood, commonly called by white people the Ravens. The Starfish was one of his emblems. The totem pole was erected about 1695 in memory of a man having the title Duwallis, which translated means sorcerer. He belonged to the Lakekeek Brotherhood known to white people as the Eagles. It is adorned with human figures, squirrels, ravens, starfishes, and other quaint figures.

The Indians relate that once upon a time the Squirrels, led by their chief, the White Squirrel, warred on the Indians of the Skeena River, giving them no peace by day or by night. They so harrassed the Indians that at last they overawed them. Then Duwallis, who was not only a noted fisherman but also a renowned warrior, came forward and fought the White Squirrel single-handed. He choked him to death and by so doing brought such dismay to all the Squirrels that it ended the war.

One day Duwallis, who is also represented at the top of an adjoining pole, in spearing a giant dog salmon was dragged out of his canoe and taken down to the dog salmon's village under the waters of the Skeena River. After spending two years in the dog salmon's village Duwallis returned to Kitwanga, knowing the habits of the dog salmon so well that he could catch them whenever he wished. Thus he became rich and powerful, but he died fighting bravely against the Indians of Kitselas who split him in two. His body, cleft from crown to crotch, is twice shown on the neighbouring pole with the dog salmon. The dog salmon is twice represented on a neighbouring pole, and from it that pole takes its name.



A RECONSTRUCTED POLE, WITH GRAVESTONE.

The gravestone in front of the totem pole was made to Indian order during re-erection and (inset) is carved with the name of the chief it commemorates. The figures cut on it are similar to those on the pole, but in White style rather than Indian art. A grave-house is seen in the left background.

The totem figure of the "Mountain Lion" was carved by Chief Jim Laknitz, and was mounted on a platform in memory of a man of Kitwanga who had the title Akteeih, "Having-no-fat-on-him." He belonged to the Lakeebu Brotherhood, commonly called the Wolves, which has the wolf for one of their emblems. The story of this figure is as follows: Long ago a man-killing mountain-lion came up from the coast, killing many Indians on the lower Skeena valley. It terrorized the Indians of the entire valley by killing children and even men and women, escaping from or killing those brave enough to attack it. It destroyed nearly all the Indians at the village on Kitaelas Canyon and continued its havoc up the valley. At Squnishtat two women were killed while picking berries. A chief named We Clots led some warriors of the Lakeebu Brotherhood who had made a vow to kill the mountain-lion or die in the attempt. They found the beast at Squnishtat and killed it, ending the terror and bringing gladness to all the Indians of the whole Skeena valley. The family to which the warriors belonged took the mountain-lion as one of its emblems.

From these few examples it will be readily seen that the totem poles are not in the nature of idols but somewhat resemble our own monuments, which often bear symbolic representations of the incident which caused their erection. It seems as difficult for the Indians to explain the meaning of a totem pole to us as it is for one of us to explain the details of architectural decoration on a great monument.

The work of preservation fell naturally into three divisions: first, winning the confidence of the Indians, and eventually their consent to work upon the totem poles; second, the engineering, the actual preservation of these decaying cedar sculptures; and third, the art work, the restoration of the colours

THE TOTEM POLES AT KITWANGA.

Pole No. 11 (nearest the camera) is called the Squirrel pole and was originally erected about 1695. The legend explaining the various quaint figures with which it is carved is contained in the accompanying text.

which had become nearly obliterated by the action of the weather. We employed only Indian workmen and only those favoured by the family to whom the totem poles belonged.

To win the confidence of the Indians was the most difficult part of the task. I quickly discovered that the owners of these poles had more objections to our touching them than I imagined. "How is it," they said, "that less than ten years ago the Government would not let us put up a totem pole and now you come here and say that the Government has sent you to put up fallen poles and try to prevent the others from falling?" One young man said: "These poles are monuments like gravestones and we do not want a show made of them for white people to stare at." So I told him of the stone monuments white men erect over the graves of their ancestors, with their armorial bearings and emblems which were in fact the white man's totems. But being of stone they do not perish, whereas the Indian's totems being of wood decay and fall, and my mission was to restore and preserve them. "When the white man visits these totems in his big churches he takes off his hat and when he comes to see the Indian totem poles he will show the same respect."

We were assisted in our work of preservation by one of the engineers of the Canadian National Railway. Our method was to cut the decayed base of the pole off at the ground level, inlay a new but well-seasoned pole in its back to support it, and then reset it in a bed of cement. The lowering and re-erecting was accomplished by means of blocks and tackle.

The art work, that is the restoration of the colours on the totem poles, was the most difficult part of the whole enterprise. Only in a few places, except on the most recent totem poles, could any signs of colour be distinguished. The older poles had been painted with Indian pigments, the compositions of which are virtually unknown. We had to fall back on the best paints available and they were applied by the Indians themselves. As we could get no help from books, and as no white man could tell us what colour went on any certain place, the oldest Indians themselves have been held responsible for the selection and application of colour, and so the results should be as nearly correct as it is humanly possible to get them.

Of the eighteen totem poles and two totem figures at Kitwanga, the Indians gave permission for the preservation of sixteen of the poles and both of the figures, and this work has now been finished. Attention will now be paid to the eighteen poles at Gitsegyucla and then those at Kitselas Canyon. There are also totem poles at Hazelton, Hagwilget, Kispiox, and Kitwancool. At these various points there are over a hundred totem poles, all within easy reach of the Canadian National Railway. For the protection of the poles there has been formed a guard of four Indian boys known as Troop No. 1 of the Skeena Boys' Guards, whose duty it is to protect the poles and the labels on them.

A New Shorthand.

A NEW shorthand which hails from America, and employs only the existing letters of the alphabet, has been given considerable notice in the press recently as a discovery of far-reaching possibilities. Already, of course, every student uses his own abbreviations when taking lecture notes, so that "Speedwriting"—as the new system is called—is a natural development of ordinary script. Hence it can be read by anyone and recorded on the typewriter, in this connexion important developments being foreshadowed in its use for newspaper reporting and cabling. It is hoped to publish an article on the subject in *Discovery* shortly, and meanwhile particulars can be had from "Speedwriting" Ltd., 95 Transport House, Smith Square, S.W.1.

Correspondence.

"HOW BEES COME HOME."

To the Editor of DISCOVERY.

SIR,

Your contributor upon this subject, in the March issue, appears to be unaware of many previous discoveries, and possibly on this account has made several mis-statements, as I will endeavour to point out. The scent organs of the honey-bee, the discovery of which is implied, though not directly stated, in the article, to have been made by Professor Karl von Frisch, was actually made in 1883 by Nassonoff, of Moscow, though he mistook their function, and suggested that they produced the perspiration of the bee.

Their true function was first discovered by Mr. F. W. L. Sladen of Ripple Court, near Dover, in July, 1900, while hiving a swarm, and he fully describes how the bees use the organ under several conditions, which briefly put are as follows:—(1) In a swarm before it has settled down in a new hive—to attract the stragglers. (2) At the flight hole of the hive—by bees returning tired or benumbed to the hive; by young bees on returning from their first flight; or by some of the bees returning from a first flight following a long confinement to the hive, as in winter. In each of these cases the bees have been uncertain as to the exact position of the entrance, but when they discover it, they will commence to hum and expose the membrane. (3) In certain artificial operations, such as when bees are being "driven" from one hive to another, or when a number of bees are shaken into a box or on to the alighting board of a hive—one of the easiest ways of demonstrating its use. This, in my opinion, fully controverts the statement that no bees had ever been observed to use the organ on other occasions than when feeding on sugar water under artificial conditions. The experiments, also, described under the heading "A scent problem," are practically identical with those carried out by Sir John Lubbock at Keston, Kent, about forty years ago, and published in his book on "Bees, Ants and Wasps."

The worst mis-statement, I think, appears on page 82, and reads: "The bee appears to share with us this power of recognition and of memorizing. All of her expeditions, however, are made with the *definite object of gathering either honey or pollen.*" Now every good bee-keeper knows that the queen and the drone bees never come out with that object; in fact, they could gather neither honey or pollen if they tried. If the statement is meant to apply to the workers only, it is still incorrect, for every young worker bee takes a course of "play spells," as they are called, but which are really locating flights, for several days before starting its gathering work. Finally, I think your contributor will admit that the workers often go out to gather propolis or water.

Docks, Bridgwater. W. A. WITHYCOMBE.

Mrs. Haldane writes:—

"The distinction between the scientific insect psychologist or physiologist and the professional bee-keeper appears not to be fully understood by your correspondent. The observation of bees which, with few exceptions, was until the middle of the nineteenth century almost wholly in the hands of those who kept them for profit, has, like other branches of science, come down to us encumbered with mythology and legends.

"Everyone knows that before the time of von Frisch many scientific workers, including the great Lord Avebury (Sir John Lubbock), had begun to deal with the subject from a strictly scientific point of view. The great merit of the work of von Frisch and his colleagues seems to me to lie in the fact that they have devised controlled and controllable experiments to aid the observation. It may well be that many professional keepers had previously observed such organs as the scent organ. But, to take an example, although they may have known of the existence of glands, the secretion of which added to honey and pollen produced the so-called royal jelly, elaborate histological investigations had to be done before it could be shown that only nurses of a certain age could produce this secretion. My article only applied to workers and not to queens or drones. If your correspondent had read my previous article in *Discovery* (May, 1926, p. 179), he would there have seen reference to the so-called 'play spells' of the young workers.

"The difference between the scientific worker and the practical man can be emphasized by an illustration from genetics. Dr. Crew, of the Animal Breeding Research Department, Edinburgh, has shown how in many cases the non-scientific stock-breeder has made valuable genetical discoveries which he was often unable to complete until aided by scientific direction, and also that in many cases he accepted as facts such phenomena as so-called 'telegony' for which there is now admitted to be no scientific evidence."

BRITISH AND AMERICAN LIBRARIES.

To the Editor of DISCOVERY.

SIR,

My Trustees will be very grateful if you can assist them by drawing the attention of your readers to the pamphlets* now published under their auspices.

If I may venture to say so, the American pamphlet has very special importance as being, so far as the Trustees know, the first modern appreciation by competent British observers of the rapidly-developing American library service. As is stated in the introduction, the five essays cover the whole of the American service from the federal library in Washington down to the libraries of small townships and counties. They emphasize throughout the importance of a comparative study, and taken as a whole they will form an important contribution to a subject which is likely to become very prominent as a result of the forthcoming report of the Departmental Committee on Public Libraries.

The Report of the County Library Conference is also of increasing importance now that the whole question of the development of the service has been the subject of a resolution by the County Councils Association. It may fairly be said that the experimental period is over, and that county authorities are now in a position to estimate its potential value and its financial requirements. It is probably known to you that the Trustees' main function is to assist experiments of a pioneer and national character. The success of their policy depends very largely upon its receiving a reasonable measure of publicity in order that it may be thoroughly investigated by the public generally. Copies may be obtained on application as below.

J. K. MITCHELL.

Secretary, Carnegie United Kingdom Trust.

East Port, Dunfermline.

* "Some impressions of the Public Library System of the United States of America. Being papers by six of the British delegates to the Jubilee Conference held in Atlantic City, October, 1926." "County Library Conference. London, November, 1926. Report of the proceedings."

Russian Expeditions to the Black Desert.

By Hugh Nicol, M.Sc.

Expeditions into unexplored parts of the Black Desert of Turkmenistan, under the leadership of Professor Fersman of Leningrad, have led to the discovery of sulphur deposits existing there in circumstances of special geological interest. The following account, including photographs of a second expedition just completed, was obtained from Russia by the author through communications in Esperanto.

DESERTS have always had a peculiar attraction for the general reader, who finds them almost as fascinating as does the student of geophysics. For even when they are the home of numbers of men, deserts remain little known and a source of curious speculation to that larger world which lives in circumstances where water supply is not one of the anxieties of life. The Sahara has been so well explored and presented in fact and in fiction that the public has a fairly vivid notion of its features, although the idea that a desert is a monotonously flat plain still exists in some quarters. There are, however, vast wildernesses in South Africa and Central Asia which are capable of surprising even the experts—the recent discovery of dinosaur eggs in Mongolia being one of the most striking finds in the history of palaeontology.* The latest news from the nearer desert of Karakoum records a deposit of several thousand tons of free sulphuric acid, which is interesting not only as a novelty but also because of the additional knowledge it affords on the processes of desert formation.

RUINS OF ANNAU IN THE BLACK DESERT.

These are situated close to Poltorack, the capital of Turkmenistan, which was selected as the base for Russian expeditions into the desert.

This discovery of what might be thought to be a *lusus naturae* was made by Professor Fersman, of the Leningrad Mineralogical Museum, during an expedition he organized in the spring of last year, in company with Dr. Scherbatchev, to explore the desert of Karakoum, while a second expedition more recently undertaken has just returned, and should shortly report on its further investigations. This region is not so remote as the great Mongolian desert; the railway makes its western fringes, and the interesting sites, such as Annau, comparatively easy of approach, but it has never before been explored by a scientific expedition. To Professor Fersman's band of explorers is due the achievement of being the first to traverse the whole desert and reach its eastern borders.

Karakoum, or the "black" desert, lies south and eastward of the Sea of Aral; from north to south it is over four hundred miles broad, and it extends over one thousand miles to the east. Its general direction is parallel to the central Asian railway running from Krasnovodsk, on the Caspian Sea, through Poltorack (pronounced Poltoratsk) to Samarkand and beyond. Lying in a region which might be called the watershed of Asia, since the nearest great rivers flow into the Arctic Ocean, the China Sea, the Persian Gulf, and the Baltic, it is nevertheless extremely hot and arid. Such local rivers as appear on the maps, the largest and most famous being the Oxus or Amu Daria, flow into the land-locked Sea of Aral, while the distances separating the desert from rivers debouching into the ocean are measured in thousands of miles.

Poltorack, the capital of Turkmenistan, was selected as base for the expedition, which comprised geologists and topographers, and was provided with radio equipment, in addition to special watertanks and other necessaries for a prolonged stay in the desert. Some ethnological findings of great interest were made as, contrary to expectation, inhabited oases were found forty miles north of Geok-Tepe and, indeed, the desert could not be called uninhabited. The population are related to the peoples of Turkmenistan; like the latter, they are engaged in nomadic occupations, chiefly hunting, and breeding of camels and sheep. They are ruled by a former

* See "American Discoveries in the Gobi Desert." *Discovery*, October, 1926.

pretender to the Chinese throne, Genair Khan. They are primitive in manners and morals, the family being the social unit and the women being practically enslaved. Possibly their utter lack of contact with civilizing influences has played a part in conserving the honesty for which they are locally said to be famous, for, although the desert is traversed by numerous camel tracks, the colleagues of Professor Fersman were the first strangers the desert people had seen for centuries. They were ignorant of conditions and events in Russia; the only foreign commerce they have had has been rare visits of individual merchants from Khiva and Persia.

The desert is not without bush growths, called *saksaûl* by the natives, who use it for fuel, but the extreme heat is oppressive to all forms of life. Even in Poltorack the summer heat attains 80° C., and the January maximum temperature is about 50° C. It was in these circumstances of great heat and aridity, some one hundred and eighty miles north of Geok-Tepe, in the neighbourhood of the springs Schiich, Chalka, and Kisil-Takyr, that the expedition found the curious formation which, for lack of a better name, may be called the sulphur hills. These hills, numbering more than thirty, rise over two hundred feet above the desert hollows, and are composed of a series of horizontal strata, in the upper part of which predominate sandstones and siliceous matter of all degrees of fineness, while the lower layers contain also gypsum and calcareous rocks. The most interesting were the superficial strata, forming a smooth cap on the top of each hill. Two layers were herein distinguishable: one, the lowermost, a snow-white, soft, porous siliceous rock which was of extreme lightness in certain locations; the other, an opal-chalcedony crust which covered and admirably protected the sulphur deposits irregularly scattered in the stratum beneath.

NATIVE WATERING HIS CAMEL AT A DESERT WELL.
Contrary to expectation, inhabited oases were found by the Russian expedition, who were the first strangers these desert people had seen for centuries.

Opal is a stone especially associated with deserts, and has been picturesquely called "the gem of the Never-Never." The finding of opal, chalcedony, and flint thus associated in the Black Desert of Asia is of interest in view of the work that has been done on the silicification of other deserts, and this deposit is quite analogous to deposits in the wastes of Kalahari, Namib, and Central Australia. The white friable rock appeared to be similar to opal; on microscopic examination it was seen to be composed of a mass of quartz grains, of which some were partly split along cleavage planes and cemented with chalcedony. A specimen was removed to the museum in Leningrad. It was noticed that the rock had a sharply acid taste, and although it was not intended to examine it at once, the observation that the label, and the cloth, upon which the specimen lay, were perforated in less than a fortnight, hastened the undertaking of complete analysis. The result was interesting—88.5 per cent of silica, only 5 per cent of water, and over 4 per cent of sulphur trioxide. Earthy matter and alkalies were present as fractions of 1 per cent, the largest amount of any one substance being 0.44 per cent of titanium oxide. The amount of *free* sulphuric acid was no less than 4.6 per cent, and this acid must have been present in a concentration of well over 50 per cent even after the transport to, and exhibition in, distant and humid Leningrad. Analyses of the acid content of other samples gave similar results, but the amounts were variable.

Free sulphuric acid is not uncommon in the neighbourhood of volcanoes; thus, Mr. C. W. Vincent, writing about the sulphur deposits of Krisuvik in Iceland, where the content of free sulphur ranges from 15 to 90 per cent, says: "The yellow sulphur earth contains about 4 per cent of free sulphuric acid, sometimes a little free hydrochloric acid, and a variety of sulphates." In the Black Desert, however, conditions are totally different. If the sulphur of the sulphuric acid found therein be derived from volcanic action, that action must have occurred ages ago, since when nothing has happened to disturb appreciably the products of oxidation. The question of the occurrence of free sulphur trioxide in Nature is

CARAVAN PASSING THE SULPHUR HILLS DISCOVERED IN THE BLACK DESERT.

The Russian expedition found more than thirty of these curious hill formations, which contain layers of sulphur compounds. Subsequent examination at the Leningrad Mineralogical Museum has indicated that the free sulphuric acid in these deposits may be considered as a mineral of distinct formation.

being reviewed by Professor Fersman in a Russian monograph upon the chemistry of the sulphur hills, but it may be briefly said here that the minerals most resembling the acid opalline rock from Karakoum are the little-studied sulphuricine from Greece and the Sicilian melanophlogite, the former being an opal containing about 80 per cent of silica and appreciable amounts of earthy matter and free sulphur. There is no doubt that the free sulphuric acid of Karakoum should be considered as a distinct mineral, and not merely as a quasi-accidental oxidation product of coexistent mineral sulphur.

Further, the discovery offers another point of singular interest, in that the Karakoum deposit is an example of a colloidal substance that has been hitherto a laboratory curiosity known to but few colloid chemists. In the course of pioneer work of Graham, later amplified by van Bemmelen, it was found that the water of an aqueous silica gel could gradually be entirely replaced by alcohol, sulphuric acid, and other liquids, giving rise to alcohologels, "sulfagels" (Graham's spelling) and so on. Opal is an aqueous gel of silica, and the acid opal of Karakoum is a sulphogel, the water of the opal having been almost completely substituted by sulphuric acid.

Such a curious product could not well exist, except in the extraordinary conditions of high temperature and negligible humidity of the Central Asian deserts. Temperature observations in the desert in October showed that the surface temperature was about 75° C, and the temperature at a depth of half a metre was 30-40° C. The sulphur originally present was in very favourable circumstances for atmospheric oxidation, which was accelerated by catalytic action of titanium oxide, and particularly by the presence of the colloidal silica. Once formed, the acid was in presence of insufficient base for neutralization; it remained free and was prevented, by upward migration (or "exudation") of silica, from sinking to a lower level. No decomposition of the acid was possible in the complete absence of bitumen, humus, or other organic matter. Even putrefaction does not occur in this region, apparently owing to the absence of bacteria; the bodies of fallen animals simply mummify and do not decompose. This absence of organic matter, and hence of volatile sulphur compounds such as are evolved in the sulphur beds of Schor-Su in Fergan, might have led to the overlooking of the existence of sulphuric acid if specimens had not been preserved for analysis.

Professor Fersman calculated the amount of free sulphuric acid, taking the conservative basis of assuming the acid layer to be only a metre thick, as over a thousand tons on the hill of Darwasa alone. Individual hills contained appreciable amounts of earthy matter; carbonates were in negligible amount in all except those of the Chimmerly group, where they were present in small quantities. On the easterly Darwase hill (Abdarasa) there was a crust about half a metre thick of gypsum and

yellow sulphate of iron, but most of the hills were free from these secondary products.

An account of the unusually devious manner in which the news of this discovery was made available may have some value. Of Professor Fersman's larger works on cosmic chemistry, one, that had been translated from Russian into Esperanto, I read with great interest and desired to translate it into English, as it appeared to fill a gap in scientific literature. The Leipzig publishers of the Esperanto edition having referred me to the translator, who lived in Odessa, it became incidentally a pleasure to supply that gentleman, who knows no English, with an Esperanto abstract of a paper in an American journal which was not obtainable in Odessa. Professor Fersman was then in Karakoum; he replied later in French to my inquiry, adding the suggestive words: "I have just returned from an arduous expedition through the desert of Karakoum, where I discovered the quite remarkable occurrence of thousands of tons of free sulphuric acid, which was absorbed in amorphous silica." This was followed by a German copy of the paper by A. Fersman and N. Wlodawetz, upon which the present article is based. A pencilled note refers to a difficultly accessible Russian journal,* but so far I am not aware that anything has been published in Russian beyond preliminary notices.

FIRST ESPERANTO STAMP.
The first ever issued with an Esperanto inscription, this Russian stamp was sent to the author by an Esperantist correspondent.

Work of importance and interest is now being done in Russia; the language difficulty, however, largely restricts the benefit, and I feel that the publishing of all scientific papers in Esperanto, on a few standard sizes of page, would be in practical keeping with the true internationality of science, and would solve problems that are yearly increasing in magnitude.

Although his name is little known outside Russia, Professor Fersman is one of the foremost geophysicists of the world, and is engaged on a study of desert formation, to which the curious discovery of sulphuric acid as a mineral species is incidental. There is a Persian legend that a cup-like depression in the earth was made by the fall of a star north of the desert of Karakoum: it is pleasant to think that even legend in that part of the world concerns itself with the structure of the earth, and it is to be hoped that valuable knowledge is to be acquired there, where until recently no traveller has been.

* Thanks are due to Mr. Clifford, librarian of the Chemical Society, for much goodwill in this connexion. The author is also indebted to the Tashkent correspondent of *Heroldo de Esperanto*, and to private Esperantist correspondents on the Karakoum borders, for local information.

Books Received

The Physiology of Reproduction in the Cow. By J. HAMMOND. (Cambridge University Press. 21s.).

The Journal of the Quekett Microscopical Club. Edited by W. S. WARTON. (Williams & Norgate. 3s. 6d.).

A Handbook to the Marine Aquaria. Third Edition. (London County Council. 3d.).

Apollonius, or the Future of Psychical Research. By E. N. BENNETT. (Kegan Paul. 2s. 6d.).

Gallio, or the Tyranny of Science. By J. W. N. SULLIVAN. (Kegan Paul. 2s. 6d.).

The Effect of Fluctuations of the Gulf Stream on the Distribution of Pressure. (H.M. Stationery Office. 2s. 6d.).

The Pioneer and Lecturer. 1927 (first half-year). Mondiale. 1s.).

The National Institute for Research in Dairying, Annual Report, 1926.

The Music of the Spheres. By F. A. GRONDAL. (Macmillan. 21s.).

Journal of the Marine Biological Association. Vol. XIV. No. 3. (Published by the Association at Plymouth. 10s.).

Two Lectures on the Development and Present Position of Chemical Analysis by Emission Spectra. By F. TWYMAN, F.R.S., F.Inst.P. (Adam Hilger Ltd. 2s. 6d.).

The Polarimeter. By VIVIAN T. SAUNDERS, M.A. (Adam Hilger Ltd. 1s. 6d.).

Report of the Oslo Conference on the Health of the Merchant Seaman. 28th June-5th July, 1926. (The League of Red Cross Societies).

A Short History of Physics. By H. BUCKLEY. (Methuen & Co. Ltd. 7s. 6d.).

The Field-Club Flora of the Lothians. (Edinburgh Natural History Society).

The Evolution of Man. By G. ELLIOT SMITH. (Humphrey Milford, Oxford University Press. 12s. 6d.).

Heat and Light. By E. NIGHTINGALE, M.Sc. (G. Bell & Sons Ltd. 4s. 6d.).

Where State Education Fails. By LUCIE SIMPSON. (George Routledge & Sons Ltd. 5s.).

Aeolus, or the Future of the Flying Machine. By OLIVER STEWART. (Kegan Paul. 2s. 6d.).

The National Physical Laboratory Report for the Year, 1926. (H.M. Stationery Office. 7s. 6d.).

The Life of Buddha. By EDWARD J. THOMAS. (Kegan Paul. 12s. 6d.).

The Broken Trident. By E. F. SPANNER. (Williams & Norgate Ltd. 7s. 6d.).

Physics for Colleges. By H. HORTON SHELDON and others. (Macmillan & Co. Ltd. 16s.).

Ancient Persia and Iranian Civilization. By CLEMENT HUART. (Kegan Paul. 12s. 6d.).

The Human Body. By TREVOR HEATON, M.D. The Simple Guide Series. (Chatto & Windus. 7s. 6d.).

Prehistoric Man. By KEITH HENDERSON. The Simple Guide Series. (Chatto & Windus. 7s. 6d.).

Mediaeval London. By GORDON HOME. (Ernest Benn Ltd. 18s.).

The Yearbook of the Universities of the Empire. Edited by WALTER H. DAWSON. (G. Bell & Sons Ltd. 7s. 6d.).

How and Where to Observe the Total Eclipse.

By J. A. Carroll, M.A., Ph.D., F.R.A.S.

Assistant Director of the Solar Physics Observatory, Cambridge, and University Lecturer in Astrophysics.

If there is any reader who has not yet decided to see the total eclipse next month, we are certain that this article will excite his curiosity to do so. Dr. Carroll describes precisely how to make the most of this event, whether it be viewed from the north of England, or from Norway and Sweden of which he has prepared a special map.

THE total eclipse of the sun on 29th June next will, unfortunately, be of extremely short duration. The maximum duration is reached at a point in the Arctic Ocean a little north of Novaja Semlja, where totality lasts only 50 seconds, mid-eclipse occurring at 6.23 G.M.T., with the sun near the meridian at an altitude of about 35 degrees. In this country the duration is about 23 seconds, but, short as it is, if the weather conditions are favourable there will be ample time to appreciate the full magnificence of the spectacle.

Choice of a Station.

In choosing a station from which to see the eclipse, it is first of all necessary to be sure that one will be within the zone of totality, and the nearer one is to the central line (*i.e.*, the line from any point on which the centre of the moon will appear to pass through the centre of the sun) the better, since it is only on this line that the full duration of totality is reached. If one is near the northern or southern limit of the zone of totality then the rim of the moon is at some point or other brought closer to the edge of the sun than it is anywhere on the central line, and so the sun is completely covered up at a later moment and is uncovered at an earlier moment than on the central line. Outside the zone of totality the sun is never completely covered, and the beauty of the spectacle is entirely lost. That a departure from totality of less than 1 per cent is sufficient to prevent any possibility of seeing the faint pearly corona and the brighter crimson glowing prominences is easily realized when we remember that the sun is 600,000 times as bright as the full moon. Thus if 1 per cent of the disc is uncovered there is still coming from it a light 6,000 times as bright as the full moon. Furthermore, the more deeply one is immersed in the moon's shadow the darker will the sky become, though, since the zone of totality is only about thirty miles wide in this eclipse, it will not be difficult for light scattered by the earth's atmosphere from the region outside, which is still lit by the sun, to reach the observer in the region of totality. However, a fairly dim twilight may be expected.

It is also necessary that the sun shall be visible to the observer from wherever he be. It is, of course, easy to ensure this by the simple expedient of getting up at the time of the eclipse on the previous morning to see if the sun is hidden by any hills, trees, or buildings, but, as this may be difficult or impossible, a knowledge of the position of the sun at mid-eclipse can be used to test the matter at any convenient time. In England and Wales the sun will have an altitude of about 10 degrees, and will have a bearing of approximately 70 degrees east of north. The altitude and azimuth* of the sun at mid-eclipse for various stations in Scandinavia are included in the table given. A high altitude of the sun is well worth securing (by going to Scandinavia) since not only are local obstructions such as buildings less likely to cause difficulty, but atmospheric haze is made of much less importance and, while this does not much matter for naked-eye observations, much better "seeing" or atmospheric steadiness is to be found at a greater altitude. A useful rough guide for measuring altitudes is the following:—Extend the first finger and thumb of one hand as widely as possible and hold the arm outstretched straight in front of one, then the distance between the tip of the finger and the tip of the thumb subtends at the eye an angle of about fifteen degrees.

The Weather.

We now come to the really uncertain part of eclipse observation, namely, the weather. Fortunately the eclipse occurs at a very favourable time of the year for obtaining clear skies, but "he would be a rash astronomer who ventured to predict for a small area in an English county the state of the sky for a period of less than half a minute at a particular hour three months ahead." A study of the sunshine recor s of the past five years, and of special observations made over the zone of totality last summer, gives certain general results, sufficiently definite to be used as a guide in choosing a station.

* The angle between the meridian of a place and a vertical circle passing through the sun.

Despite local variations there is a tendency for large belts of country to have it fine on the same morning, and for clear belts to change position mainly with the direction of the wind. The chances of clear weather may be placed at rather better than one in three, and anti-cyclonic conditions are more than twice as favourable as are cyclonic ones.

In case cyclonic conditions prevail it is well to avoid valleys and their early morning mists. A position on the east or south-east side of the high ground is desirable, not only to obtain a clear horizon in the direction of the sun, but to be on the lee side of the probable wind if cyclonic conditions prevail. A sea-coast station is liable to early morning fogs, but if these are known not to be likely to give trouble then it is advantageous, since the atmosphere is found by some observers to be noticeably steadier over water than over land.

There are two main classes of people into which those planning to see the eclipse may be divided. One includes those who must choose their station a long time ahead, such as, for example, professional astronomers who have large or complicated instruments to erect and adjust, and the remarks just made will be of most service when planning well ahead. The other includes those who can leave a decision of where to go till the day before the eclipse, perhaps camping out overnight at the selected spot, or making use of one of the special trains which the various railway companies are, I understand, planning to arrange to take people overnight to a place within the central zone and back again immediately the eclipse is over. If the choice can be left till the last day, then from the daily weather reports a convenient place can be readily chosen. If the Meteorological Office does not issue a definite forecast, a simple old rule is that the weather is more likely to repeat itself from one day to the next than to change.

It would be invidious to mention particular places as specially unlikely or specially likely to have good visibility, but were I not going to Norway, my preference would be for somewhere in Yorkshire.

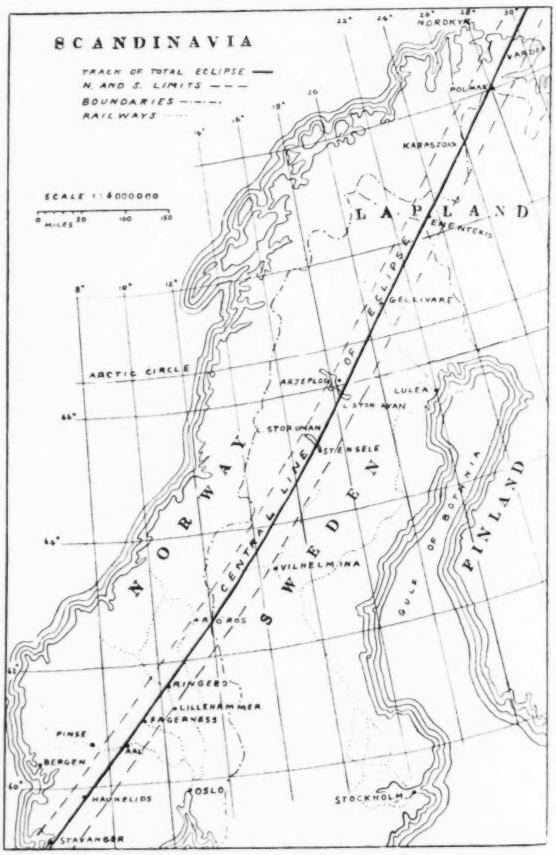
An excellent map showing the zone of totality, and the times of beginning and ending of the eclipse in England and Wales, has been published in the British Astronomical Association handbook for 1927, and doubtless other good maps will be forthcoming in the newspapers and elsewhere. Reference may be made also for details of some stations and the general run of the central line to Dr. Lockyer's recent article in these pages.*

*"The Total Eclipse of the Sun in June." *Discovery*, February, 1927.

The Eclipse in Scandinavia.

The shadow reaches the coast of Norway at 5.30 a.m., between Stavanger and Flekkefjord, whence it goes on towards the lake of Falmund on the frontier of Norway and Sweden, the border being crossed at 5.37 a.m., at Vigelfjäll in latitude 62.5°. Then it goes on over Strömsvattnet and to Lapland and the lakes of Stor-Uman and Stor-Avan, Gellivare is then passed and so on down the course of the River Tana-älv to the Arctic Ocean between the Cape of Nordkyn and Vardö, where totality lasts 45 seconds.

There is much in favour of choosing a station in Norway or Sweden from which to see the eclipse. Firstly, since the eclipse takes place in these countries at a later hour of the day than in England the sun will be considerably higher in the heavens, as can be seen from the accompanying table (it may be remarked that as far as freedom from atmospheric disturbance



MAP OF ECLIPSE TRACK IN SCANDINAVIA.

The central line of the eclipse in Scandinavia is shown in the map, and it is indicated where it is crossed by railway lines. The northern and southern limits of totality are also roughly sketched in, but merely for the sake of showing how much "leeway" is allowable; it is desirable to get as close to the central line as possible, which is the line in which the line of centres of the sun and moon intersects the earth.

TIMES OF ECLIPSE IN SCANDINAVIA.

	1st Contact (Eclipse begins).		2nd Contact (Totality begins).			3rd Contact (Totality ends).			4th Contact (Eclipse ends).		Altitude.	Azimuth.
	h.	m.	h.	m.	s.	h.	m.	s.	h.	m.		
NORWAY												
Stavanger ...	4	34.2	5	30	38	5	31	8	6	31.0		
Haukelidsaeter ...	4	35.1	5	31	59	5	32	31	6	32.7		
Aal	4	36.1	5	33	19	5	33	52	6	34.5	22°	Nearly
Fagernes... ...	4	36.5	5	33	57	5	34	31	6	35.4		East
Ringebu	4	37.1	5	34	51	5	35	25	6	36.6		
Röros	4	38.7	5	36	54	5	37	14	6	38.8		
Makur	4	53.0	5	55	2	5	55	46	7	0.5		
Nyborg	4	51.8	5	53	40	5	54	24	6	59.0	30°	S.E.
Polmak	4	51.6	5	53	18	5	54	3	6	58.5		
SWEDEN												
Unersaeker ...	4	39.6	5	38	20	5	38	57	6	40.8		
Aare	4	39.8	5	38	23	5	38	53	6	40.9	26°	E.S.E.
Gällivare ...	4	45.8	5	46	10	5	46	50	6	50.3		
ENGLAND												
Liverpool ...	4	30	5	23	5	5	23	8	6	21	11°	E.N.E.
Durham	4	31	5	25	2	5	25	4	6	23		

Note.—(1) All times are given in Greenwich Mean Time. Summer Time is one hour later. In Norway and Sweden Standard Time is one hour ahead of Greenwich Mean Time; (2) The duration at Liverpool and Durham is short because they are not on the central line, where in England and Wales totality lasts twenty-four seconds.

goes any altitude below 15° is unfavourable and anything over 20° good); secondly, the duration of totality is appreciably increased.

Weather conditions can be taken to be at least as favourable in Scandinavia as in England and Wales I think, southern Norway being perhaps the most favourable region. The Director of the Norwegian Meteorological Institute has said that:—Comparing the cloudiness in different parts of the country, it can be stated that in the month of June the sky is less cloudy in southern than in northern Norway, and that the minimum of clouds is to be found in the eastern valleys. The average cloudiness is much less for Aal and Fagerness than for Stavanger, and a good deal less than for Haukelidsaeter and Röros. Generally the sky is least cloudy in the morning hours; a morning fog occurs occasionally, but it usually clears away from one to two hours after sunrise.

The majority of the places mentioned in the table for Norway and Sweden are readily accessible by railway from the capitals, and the following information is available with regard to some of the stations in Norway. Stavanger is a stopping-place for steamers; Aal, Fagerness, Ringebu and Röros are railway stations, and Haukelidsaeter is reached by automobile. Makur is reached by steamer, Nyborg by automobile from Vadsö, which is reached by steamer. Bergen, a convenient port of entry, is reached by steamer from Newcastle.

The map reproduced shows the central line of the eclipse in Scandinavia. It is assumed that the majority of people journeying to Norway or Sweden will be free to choose a site close to this line, and they are strongly advised to run no risk of being outside the zone of totality, which extends for about fifteen miles on either side of the central line. It is not necessary to be on the central line at all exactly, but an effort should be made to be not more than say five or six miles to one side of it.

If this be done, and a station chosen from which the sun will be visible at the time of the eclipse, then a very impressive and memorable sight can be looked forward to with little fear of bad weather to spoil it, and the weirdness and awe-inspiring nature of a total eclipse of the sun under any circumstances will be not a little enhanced by the grandeur and ruggedness of the surrounding landscape.*

Phenomena.

It may not be out of place to remind readers not to look at the sun directly at all, since it seems that an eclipse always brings a rush of patients to the oculists. For examining the sun to observe the progress of the partial phases of the eclipse nothing is better than a piece of photographic plate or film which has been exposed to light and developed to a fairly thorough blackness; a few trials will enable anyone to produce a screen of the correct darkness. Such a screen

* I am much indebted for some of the information used above to communications to *The Observatory* from Messrs. J. M. Schroeter, A. Rath, and Col. Stratton.

can be tried out on the sun at any time, and it is difficult to make one that is too dark. When the last trace of the rapidly narrowing crescent of the sun has disappeared and totality has commenced the dark glass is no longer needed, and the phenomena during totality can be viewed safely with the naked eye.

There will be a progressive darkening during the development of the partial phase, but with the disappearance of the last piece of the sun a rapid onset of deep twilight will occur, deepening somewhat till mid-eclipse and then lightening towards the end of totality. The sun will be in the constellation of Gemini, and a few of the brighter stars of the surrounding constellations may be seen, such as Capella, Aldebaran, Castor and Pollux, and to those in the more northerly regions the red star Betelgeuse in Orion. A pair of field glasses or a three-inch portable telescope should make these easily visible. All the solar phenomena visible can be seen with the unaided eye, but certainly field glasses or a portable telescope will be an advantage, and can be used without darkening devices during totality. It will be well for observers to follow the example of astronomers with an elaborate instrumental programme, and plan in advance the order in which they will look for the various things to be seen, and how much time is to be devoted to each. In this way, despite the shortness of this eclipse, there will be time to see everything.

Shadow Bands.

If a station on a hilltop be selected, from which a view of the surrounding country may be obtained, the imposing onrush of the moon's shadow may be seen. During the last few moments before totality commences, and for a few moments after it ends, the shadow bands may be seen. These are alternate striations of light and shade, which may be seen on any light background such as a whitewashed wall, or even on the ground itself, and which move along with a moderately rapid rippling motion. They are due to the irregularities in the refraction produced by the earth's atmosphere, whereby the nearly plane waves of light reaching the earth from the sun are given a wavy form, as if they were ocean rollers, say, so that the light from a part of the modified wave which is convex to the observer instead of going to its normal place on the ground goes to a region where some light is already going from an adjoining concave part of the wave. The same mechanism produces the twinkling of stars at night, but the light from a star is too faint to make the bands visible, and in full sunlight the bands produced from the different points on the sun overlap and so give uniform illumination in the result.

The appearance and nature of the prominences and the corona have been described by Dr. Lockyer in the article referred to above, and need not detain us further here, except to remark that they form the most striking features of a total eclipse. The prominences glowing vividly red may rise to a distance of over 10 per cent of the diameter of the sun, and the gleaming pearly greenish-white corona, with its arches and streamers extends to a distance of perhaps a solar diameter away from the edge of the blotted-out disc.

The Flash Spectrum.

Those who have access to such instruments should, by all means, take with them any form of pocket or direct vision spectroscope (the slit of which should be removed) in order to see the "flash spectrum." This is the emission or bright line spectrum, which is the reverse of the ordinary solar spectrum of absorption lines (Fraunhofer lines) on a continuous background. This latter is formed by the absorption of light of certain wave-lengths from the continuous spectrum of the light coming from the general body of the sun, but when the disc is eclipsed this same atmosphere which extends a little way beyond it (about one half of one per cent of the solar diameter) projects beyond the moon and, since it is hot and stimulated by the solar radiation still falling upon it, it is emitting its own characteristic spectrum, the counterpart in fact of what it absorbs. In the forthcoming eclipse the moon is so little larger than the disc of the sun that the solar atmosphere will scarcely ever be completely covered at all, and the flash spectrum will be on view practically the whole time of totality. The best way of observing the flash spectrum if one has a small diffraction grating, or a replica of one, is to mount it in front of the objective of a field glass, so that the light after passing through the grating, or being reflected from it, goes through the instrument in the usual way and the spectrum is seen spread out on either side of the central image of the eclipsed sun. In particular the red and the blue lines of hydrogen should be noted, since these lines arise also from the prominences which will be seen duplicated at these wave-lengths in the spectrum, and some may be able to see as far into the violet as the H and K lines of calcium, which are very strong solar lines and also occur in prominences, which are largely composed of hydrogen and calcium vapour.

Mention may also be made of the phenomenon known as Baily's beads. These are small intensely bright patches of light from parts of the disc left uncovered after totality has commenced, owing to the fact that the moon has high mountains on it and so does not present a perfectly smooth outline; thus

a depression or valley between hills may leave a small piece of the disc uncovered for a few seconds beyond totality. Unfortunately, they cannot be predicted in advance, not so much because we do not know the shape of the moon well enough, as because the moon, owing to libration, does not always present exactly the same face to us, and this motion is not known sufficiently precisely to enable us to say exactly what the contour of its rim will be at the time of the eclipse.

Lastly, if anyone wishes to take photographs of the eclipse, it will be well to use a telephoto lens of as large an aperture as possible, since the size of image obtainable is only about one inch in diameter for every nine feet of focal length, and the camera should be focused for infinity by special focusing on the sun or moon beforehand, or on a very distant object, since the infinity catch on most cameras is at a focus for a point only about a hundred feet away. With an aperture of F/6 an exposure of a second should produce quite a good picture of the corona, though if the image of the sun is small the spreading and halation from the very bright image of the chromosphere (the source of the flash spectrum) will obscure it largely. The exposure should not be made till all trace of Baily beads has disappeared. If desired several exposures of different lengths may be made, and on the scale likely to be possible with ordinary cameras no serious blurring of detail from the motion of the sun need be feared in an exposure of several seconds.

Biological Control of Pest Plants.

By. H. H. Wardle, F.R.H.S.

Editor of "The Fruit Grower."

While considerable progress has lately been made in research on the control of weeds by insects, the failures are conveniently left alone in the press. The author discusses some typical problems for which solutions have yet to be discovered.

EVERY wild creature has natural enemies, and in the undisturbed play of natural conditions a fluctuating but on the average stable equilibrium is maintained between victim and aggressor. The interference of man upsets the swing of the delicate "balance of Nature." In this artificial condition brought about by a highly-organized modern husbandry, many attempts have been made to restore the disturbed balance by the importation of parasitic and predatory insects and animals, and their results are somewhat at variance. The successes are written up by essayists and article writers as "romances," and the failures are conveniently left alone. It was once stated by an American writer that "if insects would quit fighting among themselves, they would overwhelm the whole vertebrate series." Economic entomologists, therefore, are turning their attention more and more to the possibilities of controlling insect pests by the introduction or encouragement of their natural enemies.

A Versatile Fly.

Some time ago a paragraph appeared in the *Literary Digest* headed "A versatile fly," which stated that a fly imported from Europe by entomologists of the United States Department of Agriculture to act as a parasite on the gipsy and brown-tail moths which are so abundant in New England has proved to be even more versatile than was expected. "It has been found attacking at least ninety-two species of native insects. Certain collections of the larvae of the satin moth have been found to be parasitized as much as 78 per cent by this efficient and versatile control agent." Unfortunately, the name of this useful species was not stated in the article, and it is only just now that I have ascertained that it is *Compsilura concinnata* Meigen, and the authorities, after a study of about eight years, are convinced that the parasite will prove a very efficient control. It was not until sixty varieties of parasitic insects had been imported from Japan and Europe that this *C. concinnata* was selected, and the remarkable thing is that this immigrant, like the parasitic fly from British New Guinea which overcame the weevil (*Perkinsialla saccharicida*) of Australian origin menacing the Hawaiian sugar-cane, has shown itself likely to be helpful in getting rid of still other undesirable varieties of native "bugs" and behaving as if it had always lived there or had gone over in the "Mayflower." But Dr. L. O. Howard, chief entomologist of the U.S. Department of Agriculture, advises caution in receiving alien insects and in testing them in their new environment (a process of insect Americanization, it might be termed) before turning them loose, giving them entire freedom of the fields and forests; the successes already achieved, however, are such as to

indicate the important bearing which the "insect allies" are likely to have on the economic well-being of agriculture.

This warning which Dr. Howard has delivered may well be heeded in the experiments that are in course of being started to deal with the blackberry encroachment in New Zealand. It is a task comparable with the experiment to eradicate the prickly pear (*Opuntia inermis*) in Australia, which covers between 30,000,000 and 40,000,000 acres, principally in Queensland and New South Wales.

The Prickly Pear.

The prickly pear is not native to Australia. It was introduced into eastern Australia many years ago as a botanical curiosity, and was grown as a pot plant. It escaped, and once in the open quickly spread, so that now close upon forty million acres have been put out of cultivation. Various insects thought likely to be effective controls were imported from the warmer climes of America, and finally one of the cochineal family, *Daclylopius tomentosus*, was found capable of attacking the particular species of prickly pear which has come to be such a pest. This insect is now being distributed in enormous quantities throughout the infested districts, and results are such as to warrant the belief that it will prove one of the chief factors in the control of the pest.

But even here there is the snag which is so well put by Jonathan Swift in his lines about fleas and smaller fleas, proceeding to prey on each other *ad infinitum*, and one of the ladybird beetles has begun to attack *D. tomentosus*, and it is a question which will prevail. This occurrence, however, shows that the selection of a suitable natural enemy of a plant, as of an insect, is not so simple a matter as is supposed, and that the possibility of successful introduction and acclimatization depends upon thorough consideration of each of a complex of factors. For example, it has been reported from New South Wales that efforts to distribute the woolly aphis parasite (*Aphelinus mali*) have been partly frustrated by the larvae of the common orange and black ladybird, which not only eats up the woolly aphis, but the parasitic larvae as well. It has been found necessary to cover the branches of experimental trees with hessian bags to give the parasites a chance to increase.

One very favourable circumstance in the biological control of this cactus pest, prickly pear, is to be seen in the fact that not one of the many insect species introduced into Australia could be induced to make any other plant a host.

In the matter of the blackberry pest this aspect of the problem is likely to prove a very serious one. Dr. R. J. Tillyard, chief of the Biological Department, Cawthorn Institute, Nelson, N.Z., who has charge of the work now going forward in respect of the blackberry control operations, in a paper read before our Royal Society of Arts last year, pointed out that not only does "this terrible weed," *Rubus fruticosus*, originally introduced for its luscious fruit, spread vegetatively underground, so that each little plant soon grows to a bush, but the introduced European birds, especially the blackbird, feed ravenously on the fruit and so carry the seeds far and wide in their droppings. Nobody who has not seen this pest under the conditions prevailing in New Zealand to-day can readily understand the menace that it offers to our civilization. The general insistence on something being done has led the Cawthorn Institute to consider the taking up of this admittedly difficult problem on the lines of biological control. The chief difficulty is the central position occupied by the genus Rubus in the great natural order Rosaceae, to which most of our finest economic plants belong. Thus the risk of damage to other valuable plants is appreciably higher than in the case of prickly pear, and the safeguards imposed against the chance of such injury must be made accordingly more severe. They would not even consider the introduction of any insect which was known to feed on plants other than Rubus, and very severe testing of these on a long series of native and introduced plants would be required before their liberation could be considered.

Experiments in New Zealand.

After a search through Europe and England for supplies of insects, Dr. Tillyard recently returned to New Zealand with a collection of insect enemies of the blackberry, and also parasites of the earwig. Among the imported insects for dealing with the blackberry is, I understand, our peach blossom moth (*Thyatira batis*), not named particularly because of its association with the peach tree, but on account of the colour of its wings. Nevertheless, its host tree is the peach, as well as the raspberry, and especially the blackberry. It is, as he states, not so easy to find a determined insect specialist for the blackberry, for most of the common ones will attack other plants as well. There is the further problem that the insect which is finally selected for the work may suffer from the attention of insect enemies, just as the presence of secondary parasites or predators upon the primary parasite of an injurious insect is of very great importance from the point of view of parasite introduction. Thus this experiment in the biological control of weeds presents many points of interest of a scientific and economic nature.

Bird-Marking: Its Prospects and Results.

By E. M. Nicholson.

Interesting discoveries are foreshadowed as the result of bird-marking now being undertaken on more scientific lines than hitherto. The method is too generally viewed simply as a means of tracing migrations, whereas it is likely to throw new light on the family relations of birds and on such problems as plumage.

BIRD-MARKING as a weapon in serious ornithological research is quite a new thing. Gilbert White in "The Natural History of Selborne" gives it as a proof of bird-migration that a duck bearing the King of Denmark's arms upon a silver collar was killed in Sussex in the winter of 1708, and a resourceful observer of the same period marked swallows with dyed threads in order to confute the current theory that they hibernated under water. But such early instances are no more than curiosities of ornithological history; bird-marking at that time was rare, spasmodic, and utterly disorganized. There was not often any strictly scientific object in view, and where such an object existed the machinery was too primitive and the scale of operations much too small to allow any appreciable result. Bird-marking, in fact, depends for its success upon modern civilization; there must be over wide areas peace and a large population, able to read and more or less interested in birds, universal postage too cheap to deter people from reporting rings found, and other obvious enough conditions of the same sort.

Present Limitations.

With these minimum requirements fulfilled, bird-marking is beginning to make good progress. It has only been systematically applied during the last thirty years, and even now its potentialities are barely realized, let alone fulfilled. Glancing at the present situation we find that in Europe efforts on a considerable scale are confined to the northern and central parts. In the Latin countries the system has been little developed (though at the present moment some encouraging efforts are being made to bring France and Spain up to the mark), but at least their curiously wide definition of game results in the killing of a surprising number of marked birds, many of which are duly reported. Outside Europe North America seems to be the only field where bird-banding (as they call it there) is taken at all seriously. So we have at the outset this serious limitation of scope—practically all bird-marking at present is done in areas forming summer quarters only for the mass of their bird populations. And to mention the mass of the population is to touch upon a second obvious shortcoming. Even in this country, which Mr. H. F. Witherby and Dr. Landsborough Thomson have raised high in the scale, nearly twenty years' activity has resulted in the marking of only about 200,000 birds—an insignificant fraction, representing probably not much more than three per cent of the present bird population of Sussex alone. Even these 200,000 are spread over many bird generations, and out of them all not more than about three in a hundred are ever heard of again. Our records refer therefore to an almost infinitesimal minority, which we are bold in assuming to be a representative one.

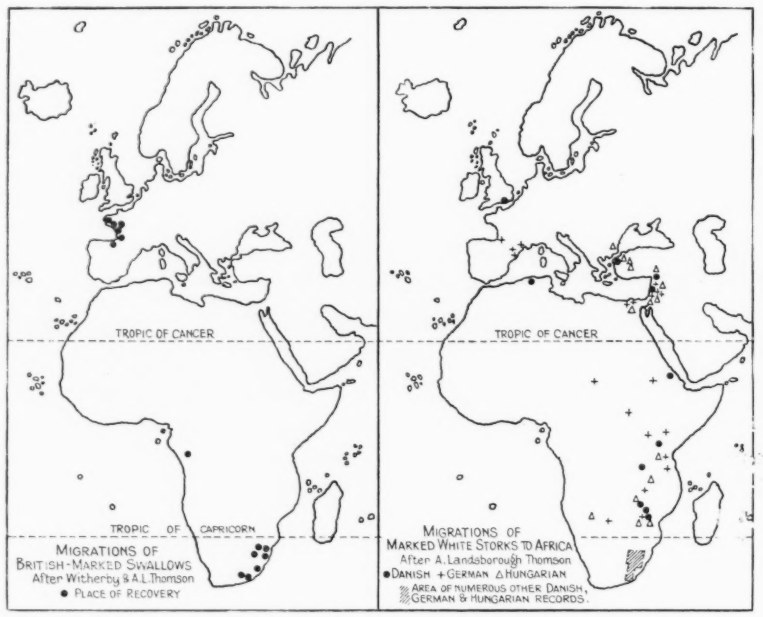
Scanty Evidence.

That British swallows winter in South Africa is a somewhat sweeping assertion to make on the strength of only seven known journeys backed by negative evidence of very dubious value. Yet this is at present one of the best-assured results of the system applied to long-distance migrations.

Obviously much remains to be done in extending investigation to other parts of the world and in increasing the scale of operations. If, for example, bird-marking were done in South Africa as freely as in England, we might obtain a double check on long-distance migrations and bring to light fresh aspects. The establishment of a few intensive marking stations, both stationary and mobile, would valuably supplement the amateur effort—for at the present stage quantity still seems more desirable than quality. A well-placed decoy pond operated over a good period on some English migration route would be a most important addition to the rather patchy information about migratory duck which the scheme has already obtained. That some such concentration of effort is desirable no one contests, though the questions whether observers should not be left the utmost freedom in their activities, and whether concentration is still desirable if it means curtailing more general work are controversial. The realization of all these potentialities is, we may hope, only a matter of time; but there are others to be considered.

At present marking is too generally viewed simply as a means of tracing migrations, and the admirable use made of it in Dr. Landsborough Thomson's recent work will probably strengthen this opinion. Actually

that is only one of its uses and (it seems worth emphasizing) the one in which its results are least to be depended on. For instance, if a swallow is ringed in England in June, and recovered in Africa in November of the next year, we have found out nothing beyond the mere fact of its presence in the two given places at the two given times; we cannot assume that it returned to its native locality in between, nor even that it returned to England—it may never have left Africa—nor have we the slightest clue to the route followed or the time taken on the journey. And these shortcomings are not simply due to the present insignificant scale of operations; they are absolute and can only partly be overcome however widely the scheme may be developed. For in the case of journey time the chances are always heavily against a bird beginning its flight immediately after it is marked and being recovered immediately on its arrival in winter quarters, and as to the route there is obviously little prospect of recording the same bird in summer and winter quarters, and also at a third point intermediately often enough to indicate the route it followed. If many British swallows are recovered on the east coast of Africa, and few or none on the west, the conclusion that most of them travel by the Nile and east coast route will not be sound unless we feel sure that all other possible routes are so well watched that marked birds would stand at least an equal chance of being reported from along them. I labour these points though Dr. Thomson has already drawn attention to the question, in order to emphasize what limitations there must always be to the building of migration theories on bird-marking results.



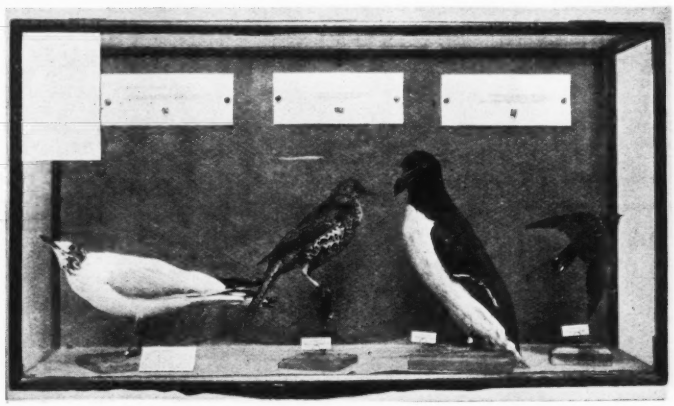
MAPS RECORDING THE MOVEMENTS OF MARKED BIRDS.

And from another aspect, though bird-marking is undoubtedly of the utmost value in studying migration problems, the observer who regards it purely or even principally as a means of attacking those problems takes a narrow and unimaginative view. Properly developed, it will throw as clear a light in many other directions. Mr. J. P. Burkitt, for instance, in his brilliant study of the robin, has shown what enormous possibilities it has as a method of tracing from day to day the personal life of the bird. One robin is very like another; they need to be distinctively marked, so that each can be recognized in the field, before it becomes possible to learn the biography of the individual bird—whether his mate is of the same age as himself, whether he takes a fresh one except after her death, how often he disappears from his territory or exchanges it for another, whether his character appears to develop as he grows older, and how long he lives.

Occasionally ordinary ringing sheds a ray of light on these questions—particularly on the age to which birds live. Concerning this some interesting details were lately collected by Mr. Witherby. The greatest age at which ringed wild birds have so far been recovered is fifteen—both the buzzard and the heron are examples. The herring-gull and purple heron have certainly reached thirteen years, the black-headed gull twelve, lapwing, white stork and common gull eleven, mallard, cormorant and blackbird ten, swallow (two records) and coot nine, and throstle almost nine. It will be surprising if these figures are not considerably increased later, for most of the schemes have not been working long enough to make higher records possible, but the short average life indicated for the starling, robin, and others which have been widely marked begins to seem normal, through default of definite cases of longevity.

Naturally, the usual marked specimens are only to be recognized in the hand; it needs a different sort of work, intensive and limited in scale, to Boswellize the lives of individual birds. While we can so rarely distinguish between two wild birds of the same species and sex, the whole world of their personal relationships is closed to us, and only bird-marking, conducted with skill and patience, can open it up. If rings are used they must be differently coloured, for the subjects of observation must be made recognizible in the field. Working along these lines we may trace a family history through many generations, building a pedigree of the descendants of one fruitful pair, and showing how many are hatched, how many die young, how many migrate and come home again later, how soon intermarriage takes place and how much new blood comes in from outside, if there is anything in the nature of a clan, or whether (as we may suspect) there are pairs which are lucky or competent, rearing many young, and others which through ill-fortune or incompetence leave none. Marital relations alone might fruitfully occupy many years of patient investigation by ringing, and there are points on which we still possess next to no reliable data. Such questions as mating for life among small birds, promiscuity, taking of a fresh partner in the lifetime of the first, the apparent dissolution of the union in winter among some species and its renewal in spring, all need exact study—hasty generalizations based on the poor scraps of knowledge which occasionally come to light are almost certainly misleading. Here, obviously, is a field where bird-marking properly applied can make our present acquaintance with even our common birds seem to us afterwards as elementary as Gilbert White's and Pennant's. We may know our native birds fairly well in a collective sense, but the individual bird is still an utter stranger to us.

To take another field in which bird-marking might be used (and to a certain extent is being used) to secure a great advance of knowledge—the field of plumage investigation. A bird needs only to be shot in order to secure a precise record of its plumage which will last, with decent care, at least a hundred years; its species is known by identification and its sex and condition by dissection, but its exact age is hardly ever known unless it is ringed, and many long-standing difficulties can only be cleared up by definite information on that point. Various large birds, for example, do not breed until they are several years old, and before reaching maturity go through a whole series of plumages, the sequence of which is often not clear. In cases of doubt ringing is the best means of showing conclusively in what order they come (unless, as is quite possible, they prove to be alternative phases) and the age of reaching maturity. Detailed records of captive specimens are, of course, numerous, but to assume that wild birds develop similarly has long been proved dangerous.



BIRD-MARKING EXHIBIT AT HAZLEMERE MUSEUM.

This display was prepared by the author, the method of marking being shown on a black-headed gull, a mistlethrush, razorbill and swallow. Rings recovered from birds are mounted at the back of the case, together with samples indicating how particulars should be recorded.

Several further examples might be given of the potentialities of bird-marking, but two must suffice here. For the first, we often attribute the decline of a species to human persecution without having more than a vague knowledge of how seriously that persecution falls on it, and without any exact information as to the proportion of all lives lost (including the embryonic stage) which are due to human agency. Now, although the proportion of ringed birds which the finders neglect to report is obviously unascertainable, we may assume, in the absence of evidence to the contrary, that it is roughly the same for all species. That is to say, in so far as reports refer to rings found on birds shot, trapped, or killed by human agency, they ought to give some indication of the proportion of loss inflicted on the species by man. The high percentage of recoveries among such birds as woodcock, snipe, lapwings, birds of prey and certain ducks promises to give some statistical data, from the other side, bearing on a fact we already know from our own—that the gun is a much more important enemy to these than it is to birds in general. It follows

that so little check is normally kept in this country upon birds like the willow-wren or cuckoo (showing a recovery percentage lower than 1) that we could not materially improve their position by giving them the most perfect legal immunity from destruction. It is only over such species as the lapwing that we have any considerable direct power of altering the position by diminishing, or increasing, or desisting from their persecution. Ringing on a large scale ought to show pretty accurately what proportion the toll of the gun bears to the whole number hatched. The importance of such data to those in charge of bird protection need not be emphasized, though it seems advisable to point out that the knowledge will not necessarily, as some people assume, support the demand for further prohibition of shooting. The results so far obtained point to a much less serious toll on birds than on fishes, amongst which up to fifty per cent of the marked specimens are often recaptured.

The last example of the wide usefulness of bird-marking is found in working out geographical status. This is the one field besides migration in which it has already been extensively applied, but though the results are already far-reaching much remains to be learnt. For instance, the recent records of trans-atlantic flights begin to put a whole group of species at present rejected from the British list in a different position. The claims of the red-winged starling, Baltimore oriole, American robin and others to be genuine wanderers are immensely strengthened by the apparent frequency of transatlantic flights among gulls and waders. It would be amusing, and by no means impossible, for the question to be settled after so long a controversy by the capture in this country of a ringed American robin with an unimpeachable record.

Improvements in Technique.

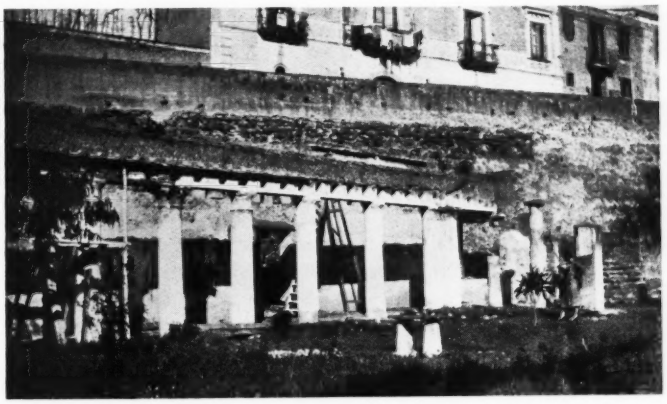
A further aspect to be considered is the development of ringing as a weapon of research by technical improvements in method. The main requirements in a bird-mark are that it shall in no way interfere with the bird and that it shall make the bearer recognizable, even after many years, to the greatest possible number of potentital finders. Some sort of light ring, carried on the foot, has so far given the best results. It has the advantage of being pliable, easy to fix but difficult to remove if properly attached, of comparative lightness and durability (Witherby rings recovered after a dozen or fifteen years' wear have remained clearly legible), while the inscription, especially the world-known name of London, brings a fair number of recoveries from distant lands. The least satisfactory feature is the smallest size, which is clumsy to manipulate and rather large for birds like willow-wrens or swallows. Mr. H. F. Witherby lately showed me an improved type, which he proposes to use instead. It is lighter and not too deep for the very short tarsus of martins and swallows; also the address has been abbreviated—too much so for the liking of the post office. A briefer address, if one could be invented, not too cryptic to convey anything to the finder, would simplify the problem of designing a satisfactory ring. When the Monomark system becomes more widely familiar it might be of the utmost service in bird-marking; if one could rely on a high percentage of recoveries being reported with such a legend as BM/ORN 3561, the rigmaroles at present necessary might be discarded, and the size of the ring much reduced, at any rate for the smaller birds. At present such an innovation would involve too much risk of reducing the efficiency of the system.

New Method of Propaganda.

It would be interesting to know how high this efficiency stands—that is to say, how many of the rings are found but not reported. Whatever it is, great improvements could undoubtedly be effected by propaganda. Many of the finders not only do not understand the ringing system, but have never heard of it. The press, though of great service in publishing details of marked birds, is often little better informed. The odds against finding marked birds will always be heavy, and it is therefore all the more necessary to ensure by every possible means that the labour of ringers is not wasted by failure to secure the highest possible percentage of reported recoveries. There are obvious methods by which the public may be led to a greater interest in the scheme and a better appreciation of its objects and results. Last summer I prepared a simple bird-marking exhibit for the Haslemere Educational Museum; since no others appear to exist it seems desirable to give a brief description of it. The method of marking was shown by the placing of ordinary Witherby rings, of the appropriate size, on three surplus museum specimens—a stuffed mistlethrush, razorbill, and flying swallow. Rings borne by a cuckoo from Ayrshire to South Germany, a chiffchaff to Portugal, and a starling from Denmark to England, together with a black-headed gull, ringed in Northumberland and recovered in Devon, were forthcoming from Mr. Witherby. The last, as a bird bearing the weather-beaten ring actually worn during a roving existence, was an especially valuable acquisition. Schedules used in bird-marking were framed to show both the instructions and the

form of record; the latter was duly filled in with the details of notable recoveries. Maps showing the movements of marked swallows and white storks (after Landsborough Thomson) and a simply-written label explaining the scheme completed the exhibit. Though through the use of available material it cost next to nothing to make, it appeared thoroughly satisfactory.

The display of bird-marking exhibits on these lines ought to benefit both the museum and the ringing scheme. They need involve very little expense, for all museums possess surplus specimens which may be pressed into service. Birds with a history in any way striking ought to be preserved for their publicity value, though unfortunately those found abroad, which would make the most effective exhibits, can rarely be recovered and set up. Even at home there is great difficulty in securing them. Last year a common heron was shot in the Midlands at the age of nearly sixteen years; it had been ringed at the outset of the scheme, and this being probably the greatest age definitely recorded in a British wild bird it had a particular value. The sender of the record, on being approached to deposit this bird on loan for a marking exhibit, replied that the gamekeeper who shot it had a long-standing promise to a friend that he would give him the next heron he secured, for a fire-screen, and this unique specimen, in spite of everything, had been sacrificed for that barbarous purpose.



NEW EXCAVATIONS AT HERCULANEUM.

This month further excavations of this buried city near Naples are to commence under the auspices of the Italian Government, as described in the editorial notes. Our photograph gives a typical view of the small part of Herculaneum at present exposed.

Attractive bird-marking exhibits may convey some idea of the scheme to the great number of people who pass through our museums every year; much ought to be done by lecturers towards educating their audiences, and much more through the press. As a subject for propaganda ringing is almost ideal; it can be made really interesting to almost any class of audience and it clashes, in a controversial sense, with nothing else (which cannot be said of bird-protection). To broadcast the knowledge of bird-marking is to increase the results accruing from a given quantity of labour, and to increase the volume of results is the only means of checking those we already have.

Perhaps in twenty years' time it would be desirable to go on to discuss at this point the actual records so far obtained, and to draw some deductions from them. There is a temptation to do that now, but we gain nothing by not facing the fact that bird-marking is still at an elementary stage. The meagre data we have are accessible to all students in "British Birds" and other well-known sources; some of them have been worked up with skill and exemplary caution by Dr. Landsborough Thomson, but to attempt at this stage to build anything more upon the inadequate foundations we have would be waste of time, and would run the risk of bringing discredit on the scheme. We must above all be careful not to push our deductions ahead of our results; on the other hand, if much is to be proved satisfactorily the scale of operations will need to be immensely extended. In 1926 we ringed 23,432 birds in this country, and that was easily the record figure; to make the scheme successful it ought to be ten times as high. The problems of interpreting records are mostly for the future; for the present the main task lies in the field.

In view of the fact that the foregoing description deals with the first bird-marking exhibit to be prepared, we learn with interest that Mr. Nicholson has just been approached by the Reading Museum for advice on the setting up of a similar display. It is also understood that the Natural History Museum in London will establish a bird-marking exhibit as soon as worthy specimens are available. At present, inquiries in the most likely quarters have indicated that even satisfactory pictures of bird-marking subjects hardly appear to exist.—Ed., *Discovery*.

Civil Aviation Spreads its Wings.

By A. E. Blake.

The establishment of air lines is now progressing so rapidly that an adequate idea of this development can best be obtained from a world survey of aviation, of which we publish below the first part. The American and other systems not here dealt with will be the subject of a later article.

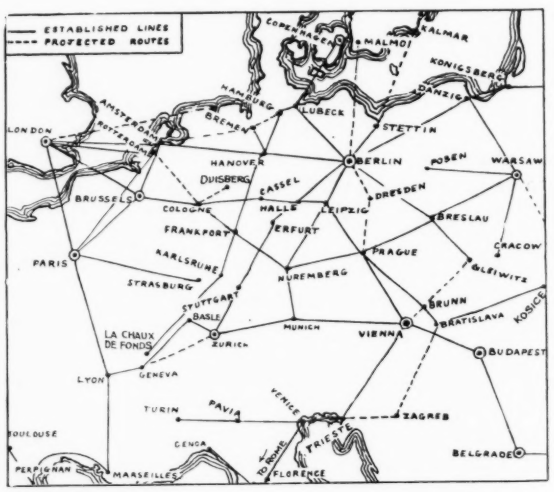
STILL fed by the taxpayer mother-bird with the worms of subsidy, the fledgling aircraft-operating industries of the world have so far beaten the air with timid pinions and have essayed only cautious little hops from one bough to the next. With the growth of strength and confidence, however, the time is approaching when they will launch themselves from the nest and will *fly*. Since the war, operators of commercial air-transport undertakings have been doing little more than gain experience, and the lines established are but small working models of airways as they will be.

In aviation it is pre-eminently true that the bold conception is the nearest to commonsense. The function of the airway is not to weld parish to parish but continent to continent, and its full value will never be realized till there exists an international network that will make the circumnavigation of the globe an affair to be reckoned in days rather than weeks. It is largely to the fact that airways have as yet been restricted to comparatively short distances that their failure to become commercially self-supporting is attributable.

Most of the post-war routes traversed highly-developed areas, well served by the established rail and sea transport undertakings, and were too short to enable full advantage to accrue from the greater speed of the aircraft. Since, moreover, visibility is at present such an essential factor in safe aerial navigation, the frequent fogs and adverse weather conditions common to north-western Europe have an immense influence on the successful operation of the British and continental lines, restricting or suspending their activities during part of the year and thus increasing the proportion of overhead charges, many of which remain constant whether or not the airway is earning freights and fares. When, therefore, one considers the measure of success which has attended European air transport, it is evident that much more may be expected when the world-routes now projected or in the early stage of operation become definitely established.

Five hundred years ago, sea transport was in much the same stage of development as modern civil aviation has at present reached, and it is probable that the world will look back on our "Argosy" and "Hercules" machines of to-day with the same amused wonder as we regard Columbus's ninety-by-twenty-foot "Santa Maria" and his even smaller "Nina." But a closer parallel would, perhaps, be found in the more rapid development of the railway, though it is to be hoped that the future airway system will not be impeded, from lack of international co-operation, by a legacy of nationalistic restrictions and duplication of services. These broad considerations may, however, remain for final comment. Some information about the long-distance routes just established or projected may be evidence of the contention that civil aviation is entering a new phase, and may also indicate probable lines of development.

A form of communication that is essentially international and intercontinental is difficult to describe regionally, but a usefully arbitrary classification that will not materially distort facts is the division of the existing and immediately-projected airways of the world into seven main systems: the Central European, the Mediterranean, the African, the Atlantic, the Asiatic, the Australian, and the North American. Of these the first three will be dealt with in the present article, this classification



MAP OF THE AIRWAYS IN CENTRAL EUROPE.

being adopted in preference to a political one, where the determining factor is the economic and military integration of such units as the British and French Empires.

The Central European system. The growth of aerial communication in Europe has been haphazard rather than systematic, and national discords and the close relation between commercial air transport and the problems of military security have seriously hampered the development of a unified system.

Great trunk routes are, however, emerging, and one of the most useful pieces of work transacted by the recent International Air Conference was the definite recognition of three main continental routes as of paramount importance. Most of the stages in these routes already exist but, where they are absent, steps will be taken to provide them and, by a closer co-operation between the operating companies, connexions will be improved and the carriage of passengers and mails expedited.

The routes comprise a north-south service from Malmo (Sweden) to Rome, *via* Berlin, Vienna and Venice; a northerly west-east line from Paris to Moscow by way of Berlin; and a southerly west-east route traversing Geneva, Munich, Vienna, Budapest, Belgrade, Bucharest and Constantinople. This skeleton will not only bring most of the European capitals into close communication but will serve to connect the whole of the European system with the great intercontinental services starting from the terminals. Thus the Paris-Moscow airway will eventually be continued across Asia to the Far East, and the Berlin-Rome line will give northern Europe access to the great Mediterranean system which is being built up by French and Italian enterprise. Other important airways already firmly established in Europe are the London-Amsterdam-Berlin, the London-Brussels-Cologne-Berlin, the Berlin - Leipzig - Nuremberg - Munich - Zurich - Marseille, the London - Paris - Lyon - Marseille, and, in summer, the Berlin-Stettin-Kalmar-Stockholm lines.

London is, clearly, a terminus and not a junction of the European airway system, and it is likely to remain relatively unimportant unless airship and flying-boat communication with the New World becomes established. Even then, however, it is doubtful if it will attain the same importance as it has gained as a seaport, since direct communication between Europe and North America is likely to follow more northerly and shorter routes, on which Iceland and Scotland would probably become of greater significance, while communication with South America would undoubtedly be by way of Spain and the Cape Verde Islands. The enormous range of the airship, moreover, will have the effect of reducing the importance of points *en route* between the terminals.

GERMAN LUFT HANSA MONOPLANE.
The latest type of machine used on the central European system, Luft Hansa being the principal German concern.

The part, in fact, that Britain is cast to play in this new act in the drama of mankind's conquest of time and space, differs in important respects from the last. Its position served it well in establishing its sea power, but is rather a disadvantage in the aerial age. It may be doubted whether the North Atlantic will ever become an important aerial highway, since it is not extravagant to expect that rapid intercontinental communication between the temperate industrial belts of America, Europe and Asia is likely to be across the Arctic and sub-Arctic, while the world is not within sight of the day when heavy and relatively low-priced commodities will be sent by air instead of steamship. Yet it cannot be said that Britain lacks an economic incentive to make it a nation of airmen as it has become a nation of seamen. The heart of an empire which sprawls over the whole world and is the least compact imperial unit should become the centre of a vast spider's-web of airways.

The Mediterranean system. Thanks chiefly to the energy and lavish expenditure of Germany, the central European system is already at an advanced stage of development, well-equipped and efficiently operated. It is otherwise on the Mediterranean seaboard, where only a beginning has been made. Nevertheless, the vigour with which services are being instituted in this

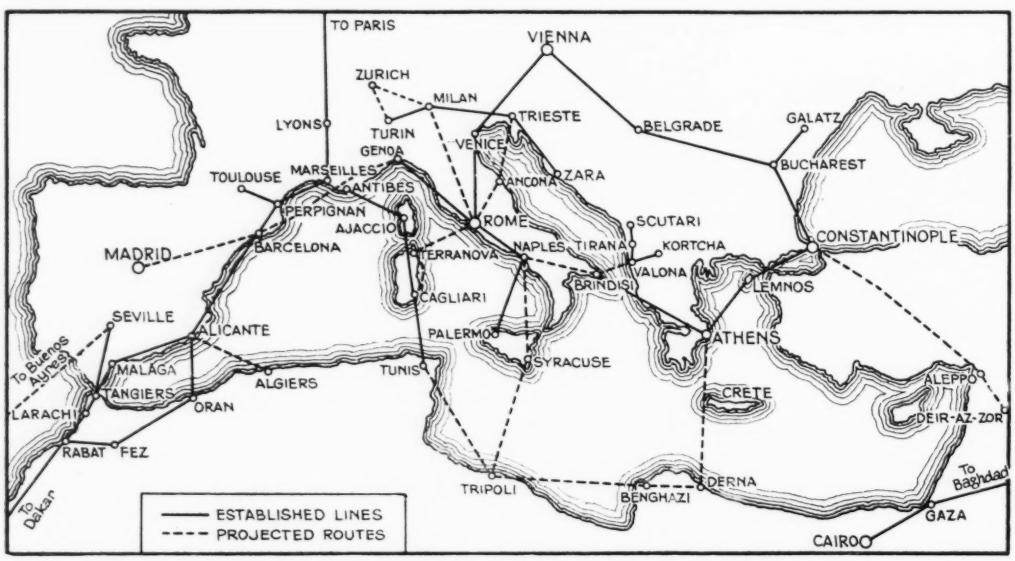
region, the manner in which they illustrate the tendency towards the establishment of long-distance airways, and the essential nature of the links they will provide in world communications between Europe on the one hand and Africa, South America and the Far East on the other, justify an account of progress achieved and imminent.

France, the pioneer of Mediterranean aviation, is concerned primarily with providing a means of integrating its African Empire with the home country, and the exigencies of the war in the Rif gave first importance to the line operated by the Latécoère Company from Marseille, along the eastern Spanish seaboard to Rabat and thence to Dakar. Later, a direct flying-boat service was established between Alicante and Oran, while Rabat and Oran were joined by a line passing over Fez. A third airway, having Tunis for its African terminal, leaves Antibes and touches Ajaccio, the capital of Corsica. Syria, now administered by France under a mandate from the League of Nations, is the object of another projected French line which will be an extension of the Paris-Constantinople service, operated jointly by French and British companies. The terminal of the new line will be Dair-az-Zor, Angora and Aleppo being places of call. If, as has been suggested, the line is further extended to Baghdad, an alternative air route to India will be provided, in place of the southerly Mediterranean line to Cairo, and thence across the desert.

Italian aviation is also, no doubt, intended to facilitate communication between Italy and its North African possessions; but its development is by no means confined to this aim. Signor Mussolini is reported to be personally responsible for the reinvigoration of Italian commercial aviation, and to aspire to make the Mediterranean, with its aid, once more a Roman lake. This grandiose scheme would certainly be aided by the establishment of the lines now in preparation. Services already operate from Brindisi to Constantinople, *via* Athens and the Island of Lemnos; from Genoa to Palermo, by way of Rome and Naples; and between Turin to Trieste, *via* Milan, with an extension to Zara, on the Dalmatian coast. A line from Venice to Vienna connects the Italian to the Central European system.

By the summer considerable progress should have been made towards realizing the extensive programme of development which has been outlined. It had been proposed that the main Mediterranean airway, of which the Constantinople-Brindisi section represents the eastern stage, should join the Genoa-Palermo line at Naples and should be extended from Genoa to Barcelona, but the necessary permission for the extension has not been granted by the French authorities. Immediately projected services include flying-boat lines from Syracuse (Sicily) to Tripoli, and from Rome to Terranova (Sardinia), thence to Cagliari, while a service from Rome to Zurich, passing over Milan, will provide an additional link with the main European system.

It has also been reported that, from Tripoli, a north-western line will connect with Tunis and an

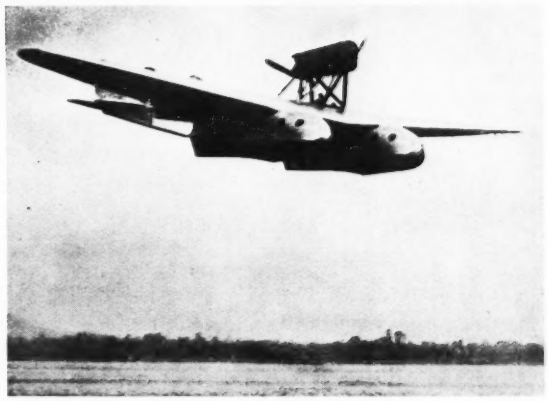


MAP ILLUSTRATING THE AIRWAYS OF THE MEDITERRANEAN AND NORTH AFRICAN AREAS.

eastward branch with Benghazi and Derna. Here communication will be made by an airway from Brindisi to Egypt which will be operated at least in part by airships. This Egyptian project may have importance for Britain in the possibilities it offers for co-operation with the Cairo-Karachi air line,* since, with its establishment, direct air communication between London and Cairo would be a simple matter of time-table adjustment.

The African system. What is, at present, the longest airway in the world traverses African territory for 2,000 miles of its length. This line, which has previously been mentioned in connexion with the Mediterranean system, links the coastal towns of Oran, Rabat, Casablanca, Mogador, Agadir, Ifni and Port Etienne, and ends at Dakar. The enterprise responsible for the operation of the service regards it as the second stage in an aerial trunk line from France to South Africa.

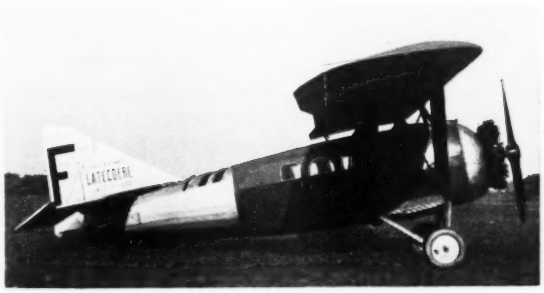
Two other airways of importance already exist in the African continent, each roughly 1,400 miles in length. One, operated by a Belgian company, serves the southern Congo basin, the line running from Boma, at the mouth of the Congo River, to Kinshasa and Luebo, ending at Katanga. It is proposed shortly to extend the service a further 140 miles to Elizabethville, near the frontier of Northern Rhodesia. M. Georges Nélis, managing director of "Sabena," the operating company, has reported as the outcome of a recent tour of inspection that the following additional services should be provided as soon as possible: (1) Leopoldville-Coquilhatville-Stanleyville, with an extension to the gold-mining districts near Moto and Kito and a branch from Coquilhatville to Bangi, on the French frontier; (2) Elizabethville-Kabalo - Kongolo - Kindu - Ponthierville - Stanleyville; and (3) Luebo-Lucambo-Kabalo-Albertville, towards Tanganyika territory. M. Nélis anticipates that, in the future, the co-operation of French, Belgian and British aircraft operating companies will enable the Congo to be connected with Europe by three main airways: the north-west seaboard line extended from Dakar to Boma and thence to the Cape; a line through the Sahara Desert, presumably an extension of the Marseille-Ajaccio-Tunis service, *via* Lake Chad, making connexion with the Belgian system at Bangi; and the British line from Cairo to the Cape.



SAVOIA FLYING BOAT.
In operation on the Italian air service between Brindisi and Constantinople.

Some progress has already been made by a British company to help to realize this scheme by the institution of an experimental seaplane service along the Nile from Khartum to Kisumu. After six months' operation it is hoped that sufficient experience will have been gained to justify the inauguration of a service of three-engined, all-metal aircraft, and also to extend the service northward to Cairo. The promoters have, however, so far experienced the most vexatious ill-fortune, both their first seaplane and that lent them by the Royal Air Force having suffered serious mishaps, the second accident occurring while negotiations were proceeding for the extension of the line southward.

At the recent Imperial Conference Mr. Havenga agreed to arrange for South African Air Force machines to make connexion with any line that could be extended to the boundaries of the Union, but no civil airway is yet in existence in South Africa. A scheme has, however, been submitted for the approval of the Union Government for the operation of a service between Johannesburg and Durban, to begin this summer, employing de Havilland six-seater planes.



MONOPLANE USED BETWEEN MARSEILLES AND DAKAR.
This line, operated by the Latécoère Co., was of particular importance to France during the war in the Rif, as a new link with its African Empire.

* As an article on this important new route appeared in *Discovery* for Dec., 1926, description of it in the present article is omitted.

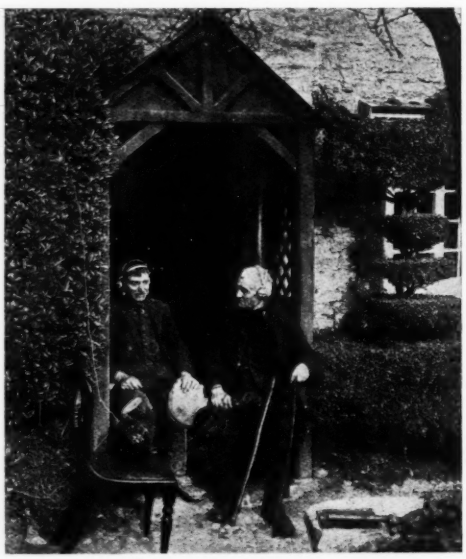
Broadcasting : A New Social Force.

By Edward Liveing, M.A.,

Manchester Station Director, British Broadcasting Corporation.

In place of our usual notes on wireless developments, we publish this month the first of a new series of articles by Mr. Liveing, who is already well known to readers as a regular contributor and former editor of "Discovery." Under the above title he will deal with broadcasting in its relation to drama, education, and other such aspects of civilization, which he introduces in the present contribution.

It is only during the last five years that broadcasting has been organized on a systematic basis in this and other countries of the world. It is still so much in its infancy, experiments are so frequently being made in the new art forms which are being evolved, and fresh fields of activity and human interest are so constantly being entered for the first time, that it would be foolish to attempt, in the series of articles of which this is the first, to lay down any dogmatic statement about its limitations and its opportunities. But I feel that there is room for a number of articles dealing with this new medium of expression in a stimulating way and attempting to suggest the position that broadcasting is taking in our social life and in relation to the progress of civilization. It is almost impossible now to open a newspaper without reading of some controversy that is being waged regarding broadcasting. These controversies often appear very petty and narrow on the surface, but in reality they possess a much deeper significance. If these articles succeed in throwing any light on the complexity of some of the problems with which broadcasting has to deal, I consider that they will have been worth while writing. My endeavour will be to put before readers some of the basic problems and questions which confront broadcaster and listener alike, and to show them in relation to other problems and questions of the day.



THE NEW FACTOR IN COUNTRY LIFE.

When it is remembered that fifty years ago very few countryfolk were able to read, yet within the past five years every third or fourth English home has installed a wireless receiver, some idea is obtained of the extent of this new influence.

In the early days broadcasting was looked upon very lightly as a sort of scientific toy—like the kind of doll familiar to our nursery days which, on being pressed by the hand, uttered weird and foolish noises. Gloomy prophecies, too, were made that the interest in broadcasting would not last and there has always been, and probably will be for many years, a school of listeners who desire to see broadcasting used simply as a medium of entertainment. Broadcasting has, however, come to embrace nearly every field of social, industrial, and scientific activity, and it is impossible to minimize its effect upon the present and future history of our civilization.

The history of world progress may be looked at very illuminatingly from the angle of mankind's growth in self-expression. It was with the coming of spoken language that concerted action by groups of human beings was rendered possible, and with mural paintings and hieroglyphics that the early civilizations of Egypt, Babylon and Crete attained the flower of their greatness. Looking so far away into the past, it is difficult for us to comprehend in any deep degree the urge and drive that must have been imparted to the mentality of the human race by the gradual discoveries and inventions first of spoken and then of written forms by which men were enabled to communicate to each other their desires, their emotions, and their thoughts. It is less difficult for us to realize the effect of the momentum given to the Renaissance by the discovery of that mechanical means of propagating ideas and knowledge offered by the invention of the printing press. The flower of the Renaissance, nurtured in the fifteenth century, grew to its full maturity in the sixteenth, and it was the invention of the printing press that played its part both as a cause and an effect

during the period of full maturity. The rediscovery of the ancient languages and the discoveries of the new world were duly described in books, and all this expression of human achievement stimulated the mind and heart of Europe to further venture and endeavour. An invention, itself sprung from a great revival in intellectual effort, had in its turn supplied new impetus to this effort, and even when the full flower of the Renaissance had passed its prime, the new invention remained as a vast and cumulative influence on the progress of civilization—an influence which has made knowledge universal in books, magazines, and newspapers, and has ever since been inseparably bound up with our industries, our art, our literature, and our educational activities.

The beginning of this century witnessed the introduction of a new mechanical achievement which, partly through misuse and partly through the limitations in its scope, has not yet played so deep a part in the intellectual and artistic life of the community as has the spoken word. Important as has been the invention and development of the cinematograph, we must rule this out of the field of comparison at present, though I hope to make further reference to it in subsequent articles. The really interesting comparison which I should like to emphasize in this introductory article is that of the printing press in the Renaissance and broadcasting in the life of the twentieth century. We are living in an age of restless experimentation in the arts and sciences, and we may aptly compare the invention of broadcasting with that of the printing press in the Renaissance, and indicate that it is destined to play a great part in the spreading of new knowledge and in the creation of new forms of art. In subsequent articles I propose to deal with broadcasting in its relation to education, world events, music, the drama, literature and poetry. Before doing this, it will be necessary to consider very broadly the advantages and limitations of this new medium of expression. The appeal of broadcasting is individual and familiar. It is not a force like the stage or the cinema, or concert-hall music, or public speaking, which make a direct appeal to crowd instincts. It is, of course, true that day by day and night by night millions of persons can hear, and do hear, identically the same music and news and talks, and that in this respect broadcasting exercises a universal influence, but it has to be remembered that these sounds have been received by individuals, or at the most by very small groups of individuals, in the quiet of their own homes and that the reaction of other people to these sounds is not visible or audible to them. The individual listener is left free to think his own thoughts, to make his own judgments and to feel his own emotions in regard to what he hears. Night by night we can listen individually and without distraction to music played by some great orchestra in a distant hall, a radio play full of changing scenes, a talk by some famous explorer telling of the latest conquest of some unknown region, news from all parts of the world given to us by the familiar voice of announcers who, to many people, have become almost members of the household, a speech by some famous politician, an explanation of some new scientific discovery. The appeal of wireless is not to crowds of collected individuals, but to multitudes of separate individuals. This medium of expression of human activities is peculiarly symptomatic of an age in which the individual's self-consciousness is developing with a rapidity which perhaps none of us can even realize. Broadcasting is bringing new horizons into the home itself in an intimate way, the full effects of which are only gradually becoming apparent.

DAVENTRY AT HARVEST TIME.

An unusual view of one of the giant masts at the principal British broadcasting station, the new art operating side by side with one of the most ancient human activities.

This has been an article of generalizations. We are creating new art forms. We must survey the ground on which we sow and we must sow in accordance with the nature of the soil. Obvious as some of these generalizations may appear, they are not always easy to put into practice. In particular, I would like to emphasize the fact that the appeal of broadcasting is intimate and individual, for it is this conception which will become apparent in the next article of this series—"Education through the Air."

Book Reviews.

The Tomb of Tut-Ankh-Amen: Discovered by the late Earl of Carnarvon and Howard Carter. Vol. II. By HOWARD CARTER, Hon. Sc.D. (Yale University). With 153 Illustrations from Photographs by HARRY BURTON. (Cassell & Co. 31s. 6d.).

REVIEWED BY THE HONORARY SECRETARY OF THE ROYAL ANTHROPOLOGICAL INSTITUTE.

It is no exaggeration to say that no discovery in the domain of science has ever aroused such immediate and world-wide interest as that of the tomb of Tut-Ankh-Amen. It was not long, however, before the exaggerated importance attached to it, largely owing to an injudicious press campaign, was succeeded by an undue depreciation of its historical and archaeological value. A sense of proportion, which is reflected in Dr. Howard Carter's second volume, has now placed this unique find in a truer perspective, and as the reaction from the hectic excitement of the earlier days of discovery has died away it has come to be recognized that, however unimportant this monarch may have been in the long history of Egypt, both as an individual and as a ruler, his tomb and the objects which it contained have granted us much new information relating to funereal customs and ritual, has enlarged our conceptions of Egyptian art of the period, and, inferentially, has thrown fresh light upon the troubled times in which the stream of Egyptian belief retu ned to its normal channels from the diversion caused by Akn-Aton, the heretic king.

In his first volume, Dr. Howard Carter has described the circumstances of the discovery and opening by Lord Carnarvon and himself of the Royal Tomb in the Valley of the Kings. He now, after such recapitulation as is necessary to remind his readers of the facts, turns to describing the events of the three succeeding seasons' work. Before actually doing so, however, he has felt it necessary to summarize briefly the unfortunate series of events which led up to the stoppage of the work by the Egyptian authorities, and its resumption as the result of protracted negotiations under a new concession granted to Lord Carnarvon's widow. As a matter of history it is no doubt desirable that this record should stand; it is neither desirable nor politic that the matter should be further discussed. Dr. Carter deals with the facts with becoming reticence.

Dr. Carter's narrative of the progress of the work of excavation covers ground which, up to a certain point, is already familiar to the public though necessarily not in such detail as it is here given. It deals with the opening of the burial chamber, the discovery of the series of four shrines, the opening of the sarcophagus and the series of coffins, and the unwrapping of the mummy. The accompanying objects found at each stage are described in detail. They are of absorbing interest. Many are unique and seeing that, as Dr. Carter points out, they fall into two classes—those belonging to the funereal ritual and those which express a personal element, whether in the character of the king, or in his relations with members of his family and household—they possess a scientific value and at the same time give a warmth and intimate emotional colouring to the knowledge which has now come to us from this remote past of over three thousand years ago.

A number of appendices follow the narrative, dealing with the finds from various points of view, such as the character of the flowers of which the wreaths found on the mummy were made, the chemistry of the tomb, and so forth. One appendix consists of notes on the objects figured in the long series of very excellent plates. Dr. Douglas Derry contributes an appendix dealing with the results of his examination of the mummy. It was expected that the examination of the only undisturbed royal mummy would prove of exceptional interest and importance. Unfortunately these hopes were doomed to some extent to disappointment owing to the conditions set up by the use of a resinous liquid for the ritual annointment of the mummy and its innermost coffin. Yet, although Dr. Derry was unable to remove the mummy from the coffin to which it had become attached by means of this material, his examination yielded some results of the greatest interest. The king would appear to have been about eighteen years of age at the time of his death. It is significant that in stature, and in the size and shape of his head he bears a striking resemblance to Akn-Aton. The shape of Akn-Aton's head is so remarkable that it was at one time thought that it was diseased. This is probably not the case; but it suggests a close relationship between the two kings, and affords ground for the suggestion that Tut-Ankh-Amen was the son as well as the son-in-law of Akn-Aton. The view that this peculiar form of head was a family characteristic is further supported by the shape of the portrait head of one of Akn-Aton's youngest daughter, discovered during the present season by Mr. H. Frankfort while excavating for the Egypt Exploration Society at Tel el-Amarna.

Where so much is new and significant, it is difficult to do justice by the selection of matters for comment. Dr. Carter's narrative must be taken as a whole in order that its many-sided interest may be appreciated to the full. The reader who seeks to know something of the rare but exquisite thrill of archaeological discovery may safely be left to his guidance.

E. N. FALLAIZE.

Under Sail in the Frozen North. By COMMANDER F. A. WORSLEY and GRETTIR ALGARSSON. (Stanley Paul. 18s.).

REVIEWED BY THE DIRECTOR OF THE POLAR RESEARCH INSTITUTE, CAMBRIDGE.

"To fly to the Pole, crash the machine, and sledge back." That and nothing less was the first plan of this expedition, but the preface mentions several other plans, including one of purchasing an airship for £2,000—a truly remarkable quotation. Indeed the preface, written by one of the joint authors, reveals any amount of eagerness but also a lack of balance and foresight, so that it was perhaps as well that ultimately the wings of the expedition were literally clipped and neither aeroplane nor airship figured in the equipment. Conceding all we can to the fire of youth and the spirit of adventure, we cannot help remarking that Mr. Algarsson's plans as sketched briefly in his preface, and as they appeared in the press, possibly embroidered by other pens, were regrettably grandiose and vague. Inevitably the actual achievements of the expedition which promised so largely are disappointing by comparison.

The main text of the book, however, is written by one who has had longer and more stirring sailoring in polar regions than almost any other Britisher. One does not find the navigator on Shackleton's marvellous boat journey from Elephant Island to South Georgia promising more than he can perform, though just how much he did perform in nursing a disabled and under-equipped ship in polar seas is hidden by his numerous tributes to the ability and readiness of his more or less amateur crew. He will probably be the last to claim that

he is as facile with his pen as he is with his sextant or with his tongue—indeed not a few references to sailorly language occur in the book—but he has usually had the good sense to stick to the log-book style, and the book therefore reveals the man. Occasionally, however, he attempts higher flights in describing sunsets or scenery in passages which actually mar where they are intended to embellish. In the main, however, the book is a plain and even naively blunt narrative of an expedition, ill-equipped and vaguely planned, but carried out with a determination and scorn of risk which provides a lesson for many a venture more reasonable in its purpose but of fainter heart.

The members were mostly voluntary and amateur, and the initial cost of the expedition—£3,000—is remarkably low. Consequently, accidents to gear were rather frequent, the time available for the scientific side of the business was brief, and the voyage throughout was perhaps too highly seasoned with adventure to allow of valuable results. But the fact remains that in spite of a broken propeller, faulty rigging, and a precarious rudder, the "Island" cruised for a long season in seas rarely visited, and made soundings, marine collections and surveys where few or none had been made before. That most of the party thoroughly enjoyed their hard life is clear from the book; that they received a magnificent training in "sails" is also to be inferred. Whether they also learned the true inwardness of scientific exploration is perhaps open to doubt and was indeed hardly to be expected.

The author gives a vivid description of a Norwegian pilot whom he met in Spitsbergen, and since it would almost equally apply to the author himself, we take the liberty of quoting it. "Svenson's point of view seemed to be that life was funny, but that it only became a really hilarious, rollicking joke when his ship was about to founder, get crushed in the ice, wrecked in a hurricane, or something of the sort." Readers may be permitted to imagine a certain amount of grim glee on the face of the commander when the propeller was smashed against the ice, when the boat-davits threatened to carry away the bulwarks in a gale, when the ship spent thirty-six hours in a first-class risk among the rocks of "Hell's Kitchen," or when being towed through fog at ten knots by a 6,000-ton steamer.

Of the scientific results the most interesting are perhaps the hydrographic, given in an all too brief appendix, and reproduced over the Admiralty chart of the regions. The accuracy of the alterations suggested is probably of a high order, and it is to be hoped that the data have been deposited in a safe and proper place.

A very readable book, which will appeal especially to those who love the sea and bemoan the dearth of sailors who really sail. Here at least we meet a group of men who have thoroughly learnt what sails can do and what they cannot do.

F. DEBENHAM.

The Effect of Fluctuations of the Gulf Stream on the Distribution of Pressure over the eastern North Atlantic and Western Europe. Geophysical Memoirs No. 34. By C. E. P. BROOKS, D.Sc. (H.M. Stationery Office. 2*s.* 6*d.*).

Tradition ascribes the favourable climate of western Europe to the waters of the Gulf Stream; that being granted, we may reasonably suppose that fluctuations in the strength of the Gulf Stream play some part in the variations of European weather from year to year and from season to season. This effect is investigated in detail in the report under review, and is found to be real and appreciable, but complex.

The origin of the Gulf Stream is the warm surface water driven into the Equatorial Current by the north-east and south-east trade winds; passing through the West Indies or round the Gulf of Mexico, this warm water travels along the American coast to Newfoundland, whence it is driven eastwards by the prevailing westerly winds. A fact which will give a new conception of ocean currents to many readers is that from the eastern tropical Atlantic to the west coast of Europe the journey takes a year or fifteen months; strong trade winds being reflected after this interval in the surface temperatures of the north Atlantic west of Ireland. The effects of the north-east trade wind differ from those of the south-east, however, in a way which may be made clear by an example. If the north-east trade wind is unusually strong in January to March of one year, the surface temperature west of Ireland will be high in January to March of the following year, but this effect is transitory, and is succeeded by a rapid fall, so that from April to December the temperature will be below normal. On the other hand, suppose the south-east trade wind to be above normal from January to March of one year, no effect will be noticed until April of the following year, when the surface temperature will rise, and will remain above normal until December. These differences are due to the shape of the Atlantic, and particularly to the great bulge of West Africa.

The Gulf Stream is modified by conditions in other parts of the Atlantic—in the Gulf of Mexico, the neighbourhood of Bermuda, the Newfoundland Banks, and the mid-Atlantic between Iceland and the Azores—but these modifications are less important than the original impulses due to the trade winds, which are thus shown to be numbered among the makers of British weather.

To America in Thirty-nine Days: Before Steamships crossed the Atlantic. By JOSEPH BIGGS. (1809-1895). (The Village Press, Idbury, Oxon. 3*s.* 6*d.*).

A Colonist's Voyage to New Zealand: Under Sail in the Early Forties. By the late ALFRED FELL. With a Foreword by his son, SIR ARTHUR FELL. (Simpkin, Marshall. 2*s.* 6*d.*).

Whilst there is nothing startling or unusual in either of these two small books, they were both worth putting into permanent form, if only to show the immense advance which has been made in speed and the amenities of ocean travel within the last hundred years. To take the extract from the diary of the late Joseph Biggs, of London and Leicester first. The title is, perhaps, somewhat misleading. The voyage in the "Independence," under Captain Nye, early in May, 1837, took thirty-nine days from Liverpool to New York, and the return journey (which involved a collision), twenty-one, yet the author's actual account of both passages occupies only six and a half pages of the twenty-six pages which the book contains. Even in this small space, however, he manages to convey a vivid impression of life on board. Mr. Biggs went to America on a business trip. The remainder of his book is made up of pictures of Broadway "in all respects like a foreign city, and it is almost with a feeling of surprise that I find the people speaking English." Boston, where he summoned up courage to call on the great preacher of the day, Channing—visits to Niagara and Montreal, and shrewd observations of all he saw around him. His description of his visit to the Niagara Falls, where, incidentally, he encountered Captain Marryat, closes thus:—

"I left the falls of Niagara on the Canada side and embarked on Lake Ontario in a splendid steamboat called the 'Great

Britain,' an English boat with the British flag at the gaff, a most welcome sight in contrast to the continually recurring stars and stripes, and it gladdened my heart to hear a military band on board playing 'God save the King.' (I have often tried to analyse this feeling, which is rather an unworthy one, and which an Englishman ought not to feel towards a people speaking the same language, and claiming the same ancestry as himself, but it is nevertheless a feeling that strengthens with his stay in America, in spite of good sense or philosophy)." But, then, that was written ninety years ago.

The author of the "Journal of a Voyage from London to New Zealand," who was one of the earliest settlers in New Zealand, and the founder of the firm of Fell & Seymour, describes, on the other hand, his day to-day experiences more fully. The "Lord Auckland," of 628 tons register, sailed from London to Nelson at the end of September, 1841, and reached her destination at the end of February, 1842, but unfortunately where we are concerned the voyage passed uneventfully—Mr. Fell became a leader among the passengers, and we are given a series of descriptions of the services (disturbed on one occasion by a vagrant "porker"), the debates, the theatricals, the washing days, the births and deaths, the editing of the ship's paper, and the meals which lightened the daily monotony on board. An extract will show that the commissariat was neglected as little then as now :—

"*Sunday, October 31st.* The heat is becoming excessive. Service was performed as last Sunday on the quarter-deck, the awning protecting us from the sun. Afterwards we amused ourselves with the flying fish darting out of the sea in shoals of hundreds all round the vessel, like flocks of birds. They are a beautifully formed fish, about ten inches long, and with wings that will carry them a great distance. This, of course (as the most trifling thing breaking upon the monotony of the voyage will do), afforded infinite amusement. We had an excellent dinner: a salmon preserved and as fine as ever I tasted, soup (and sailors make capital soups), a roast goose, a saddle of mutton, a couple of fowls, with curry and a Westphalia ham, plum pudding and apple tarts, cheese, and bottled porter, champagne and sherry, with dessert consisting of apples, nuts, almonds, raisins, etc. We had some capital port. The officers of the ship dined with us (altogether twenty-two of us), and a really elegant affair it was. Afterwards we smoked and told yarns till midnight on the poop."

Truly there were compensations to it all.

H. A. J. W.

Gallio, or the Tyranny of Science. By J. W. N. Sullivan "To-day and To-morrow" Series. (Kegan Paul. 2*s.* 6*d.*)

It is not apparent until the last page of this interesting little book is reached why Mr. J. W. N. Sullivan has associated Gallio in its title with the "tyranny" of science. That the name of Gallio—who was proconsul of Archaia in A.D. 53—has become a synonym for easy-going indifference is due to the report that he "cared for none of these things" (*Acts* xviii, 17), which follows the judgment he pronounced to the Jews who had accused Paul before him of teaching contrary to the law: "But if," said Gallio, "it be a question of words and names . . . look ye to it; for I will be no judge of such matters." Contrary to science being a tyranny, Mr. Sullivan concludes from an examination of its teachings that they are "merely irrelevant." Yet in our opinion a study of his views suggests that fundamentally the title he has chosen for them is no more representative of his actual philosophy than was the meaning attributed to Gallio's words by the author of the *Acts*. For the true lesson of science is not a matter of "words and names." . . .

Far from regarding it as inevitable that science should cause people to adopt a purely materialistic conception of the universe in the interest of "intellectual honesty"—though he does not doubt that this was necessary in the case of such early investigators as Huxley—Mr. Sullivan affirms that the most up-to-date theories lead to the conclusion that "there are no indubitable certainties in science." It "does not, and never has, brought forward sufficient evidence to justify a man turning materialist against his will"; and the fact that the Einstein and other new theories have introduced fresh conceptions has made a humble and receptive attitude of mind more than ever necessary towards science. The more we learn, in fact, the more we realize our ignorance, and one of the great discoveries of the relativity theory is that the laws which govern the universe need be no more depressing than the laws of Euclidean geometry. "No artist has felt his aspirations baseless because he cannot draw a circle whose circumference is six times its radius. He has no more right to despair because there is an inexorable law of gravitation."

The attempt, however, to express everything in terms of measurement—a survival of the purely materialistic outlook which is still active in many branches of science—has led to a great deal of useless and misleading work, and in this connexion many practices of the pseudo-sciences are reduced by Mr. Sullivan to true perspective. "It is so much easier," he says, "to make measurements than to know exactly what you are measuring," and in their eagerness to measure our researchers seem to lose their ordinary common sense. In the attempts to explain psychological happenings in terms of physiology, for instance, "learned and acute men, caught in the jungle of neurology, painfully fight their way out with some such epoch-making discovery as that one learns a subject more rapidly if one is interested in it"—nothing more or less than "a perfectly obvious fact of experience."

Though, as we have said, Mr. Sullivan concludes his book with the argument that the teachings of science are merely irrelevant, a truer representation of his conclusions appears on an earlier page, when he says: "The next step upward in the development of the human consciousness will not be achieved either by credulity or slovenly scepticism, but only by a terrifying mental travail. I see a human mind as some multiple plant here in full flower, there still in the bud. . . ." It is obvious from this passage that he does not simply "care for none of these things"; he shares with Gallio a philosophy, the more profound because it is not a matter of a particular materialistic definition, which is expressed in other language by a quotation he gives from Wordsworth :

> 'Ye Presences of Nature in the sky
> And on the earth! Ye Visions of the hills!
> And Souls of lonely places! can I think
> A vulgar hope was yours when ye employed
> Such ministry, when ye through many a year
> Haunting me thus among my boyish sports,
> On caves and trees, upon the woods and hills,
> Impressed upon all forms the characters
> Of danger and desire; and thus did make
> The surface of the universal earth
> With triumph and delight, with hope and fear
> Work like a sea? . . . .'

J. A. B.

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